

FIG. 1

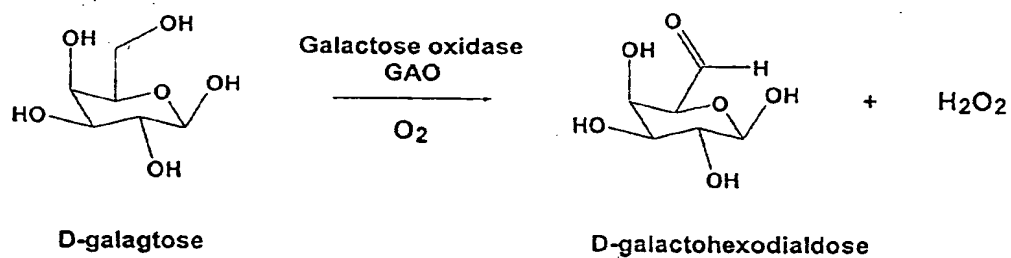


FIG. 2

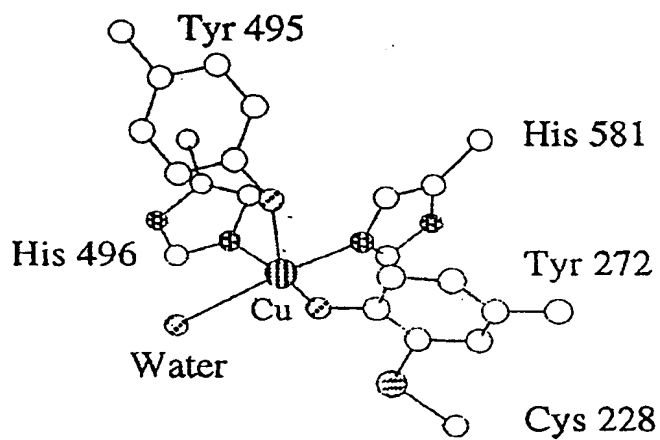
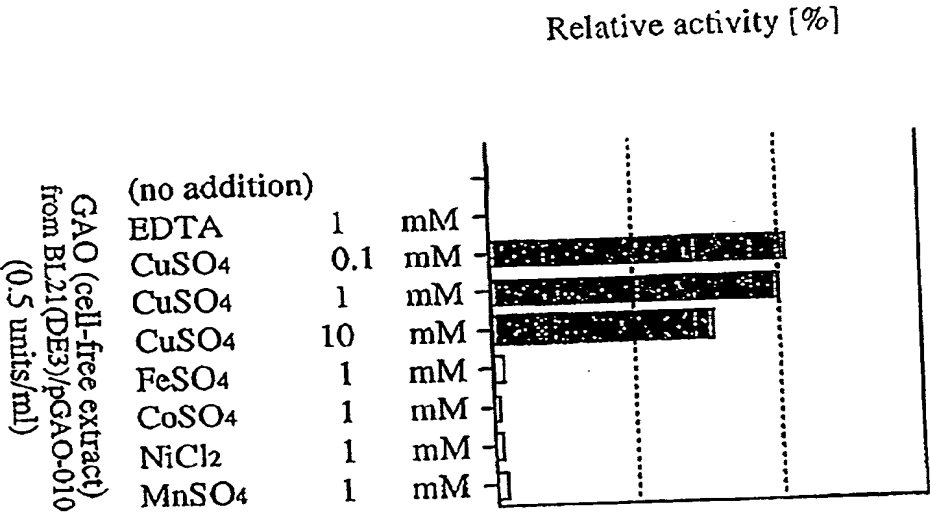


FIG. 3



007334000-4-207700

FIG. 4

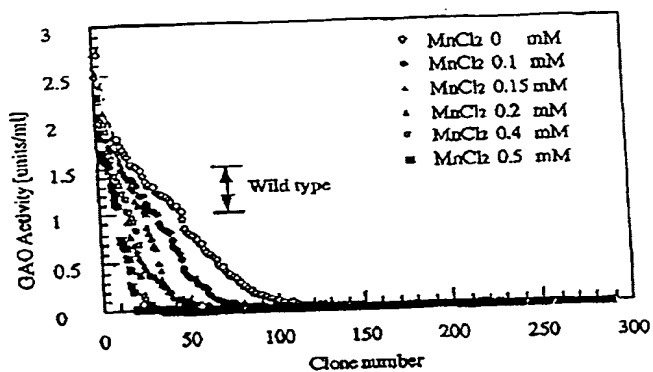
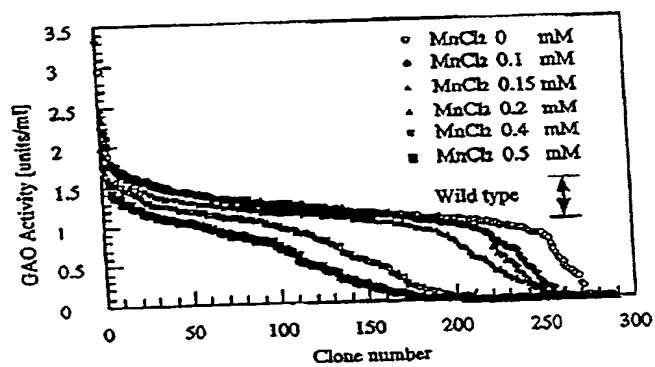


FIG. 5



**FIG. 6**

**PCR primers**

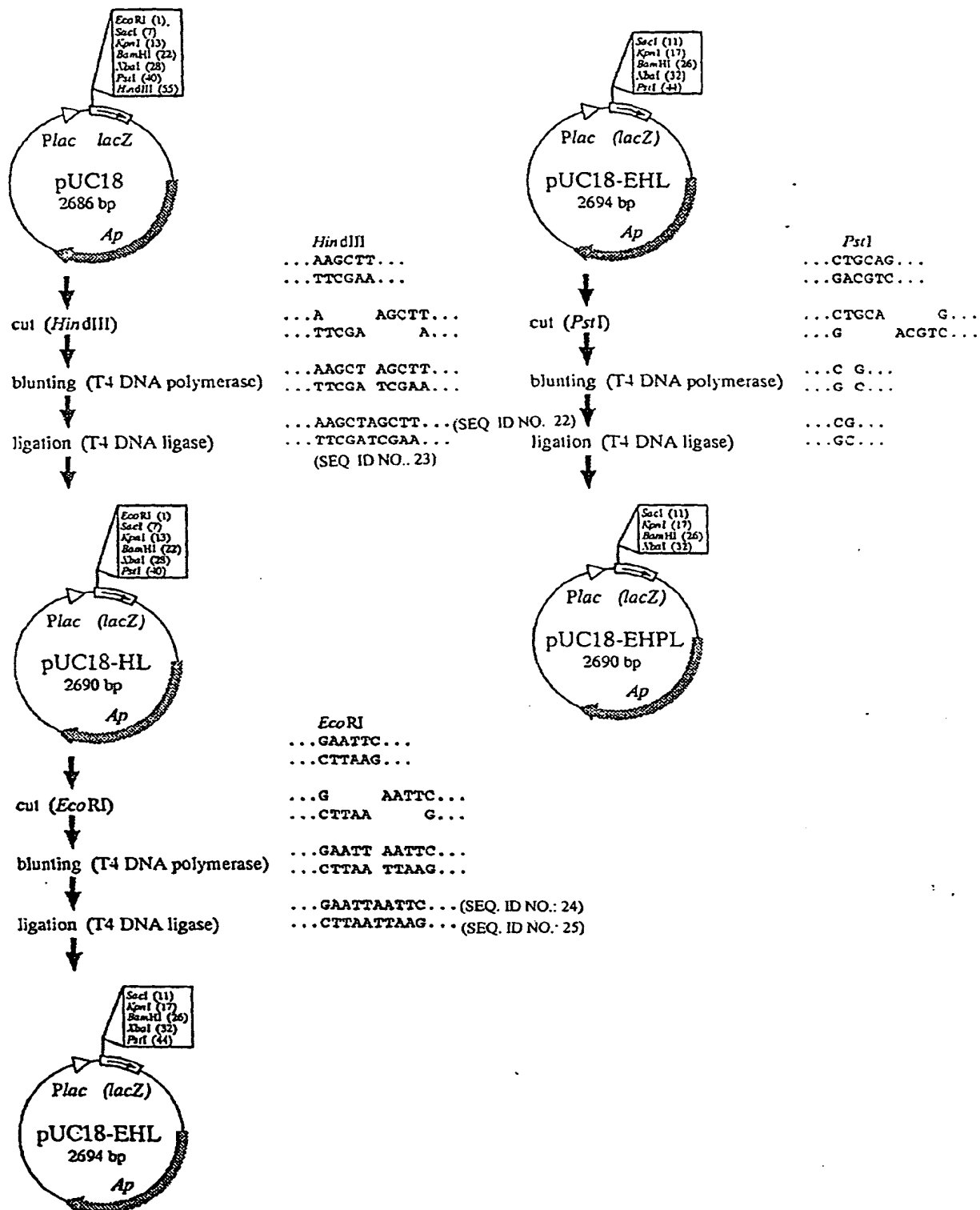
**Sequence**

MY

001	5'-AAT TCG AAG CTT ATG GCC TCA GCA CCT ATC GGA AGC-3'	SEQ. ID NO. 1
002	5'-CTT CCT TCT AGA TTA CTG AGT AAC GCG AAT CGT-3'	SEQ. ID NO. 2
003	5'-GGA AGA GAA TTC AAT ACG CAA ACC GCC TCT-3'	SEQ. ID NO. 3
004	5'-GGT CAT AAG CTT TTC CTG TGT GAA ATT GTT AT-3'	SEQ. ID NO. 4
005	5'-ACC ATG ATT TCG ACG TCG GTA CCC TCA GCA-3'	SEQ. ID NO. 5
009	5'-CTT CCT AAG CTT TCA CTG AGT AAC GCG AAT-3'	SEQ. ID NO. 6
036	5'-GGA AGA GGT ACC AAT ACG CAA ACC GCC TCT-3'	SEQ. ID NO. 7

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FIG. 7



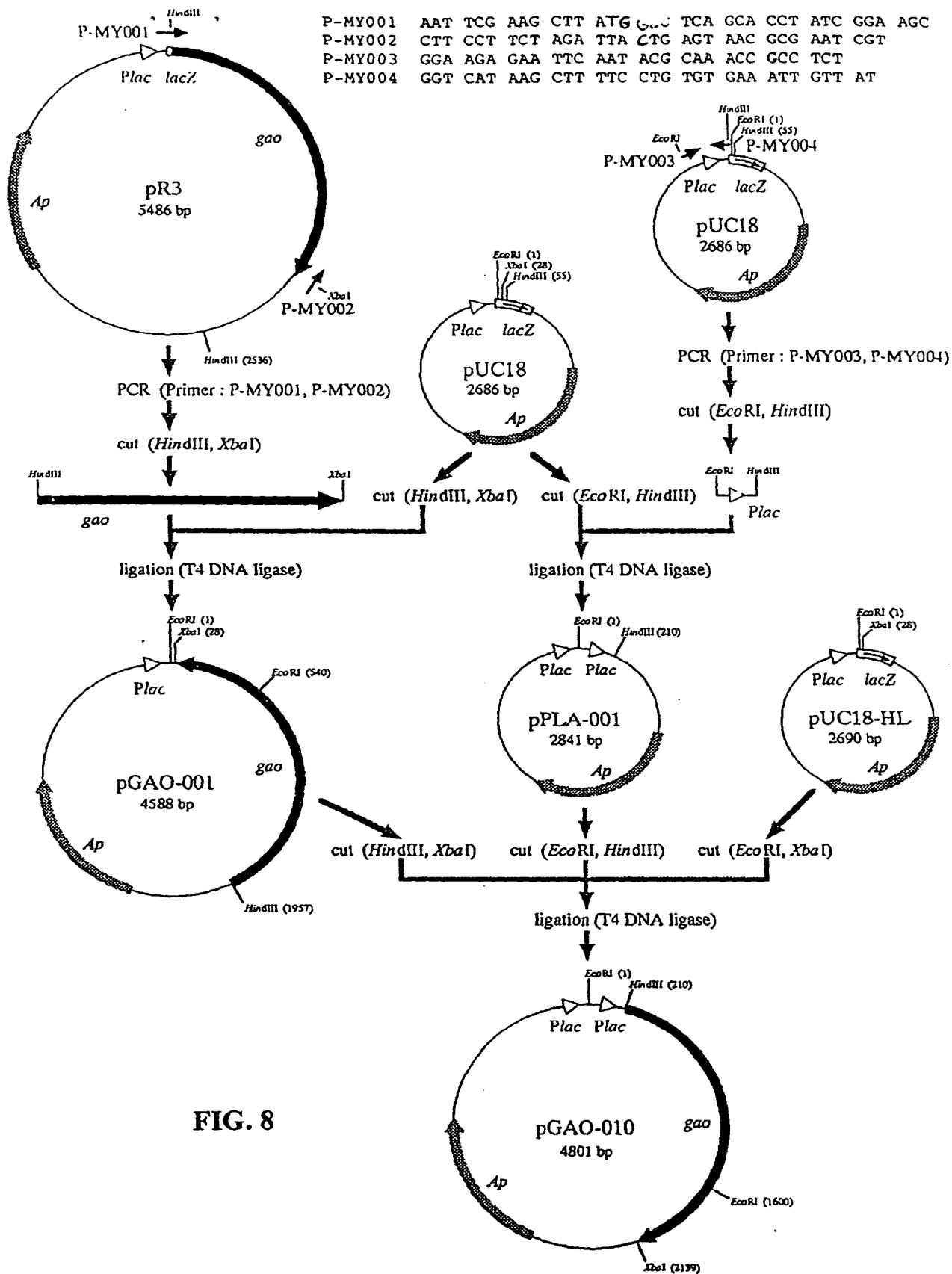


FIG. 8

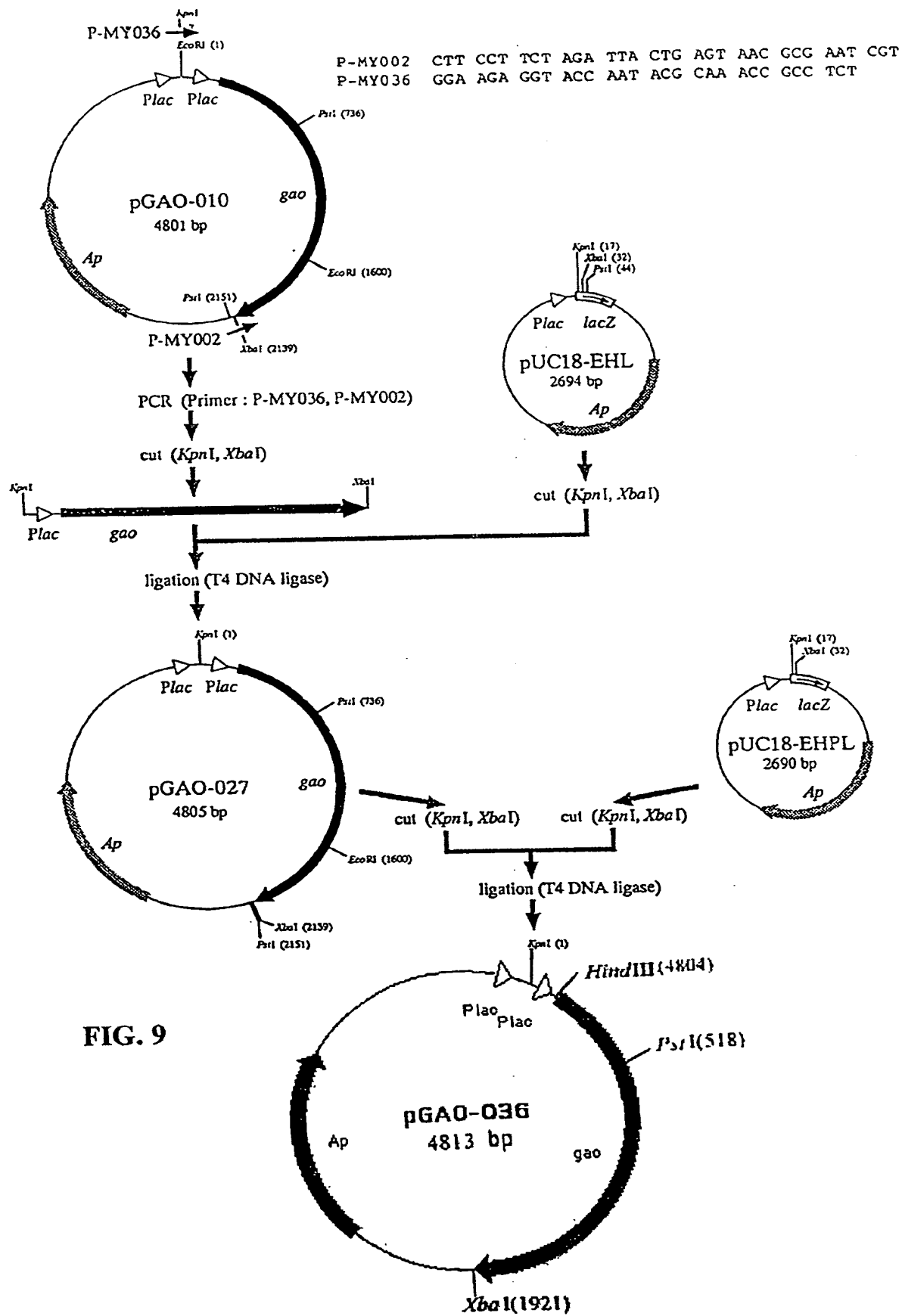


FIG. 9

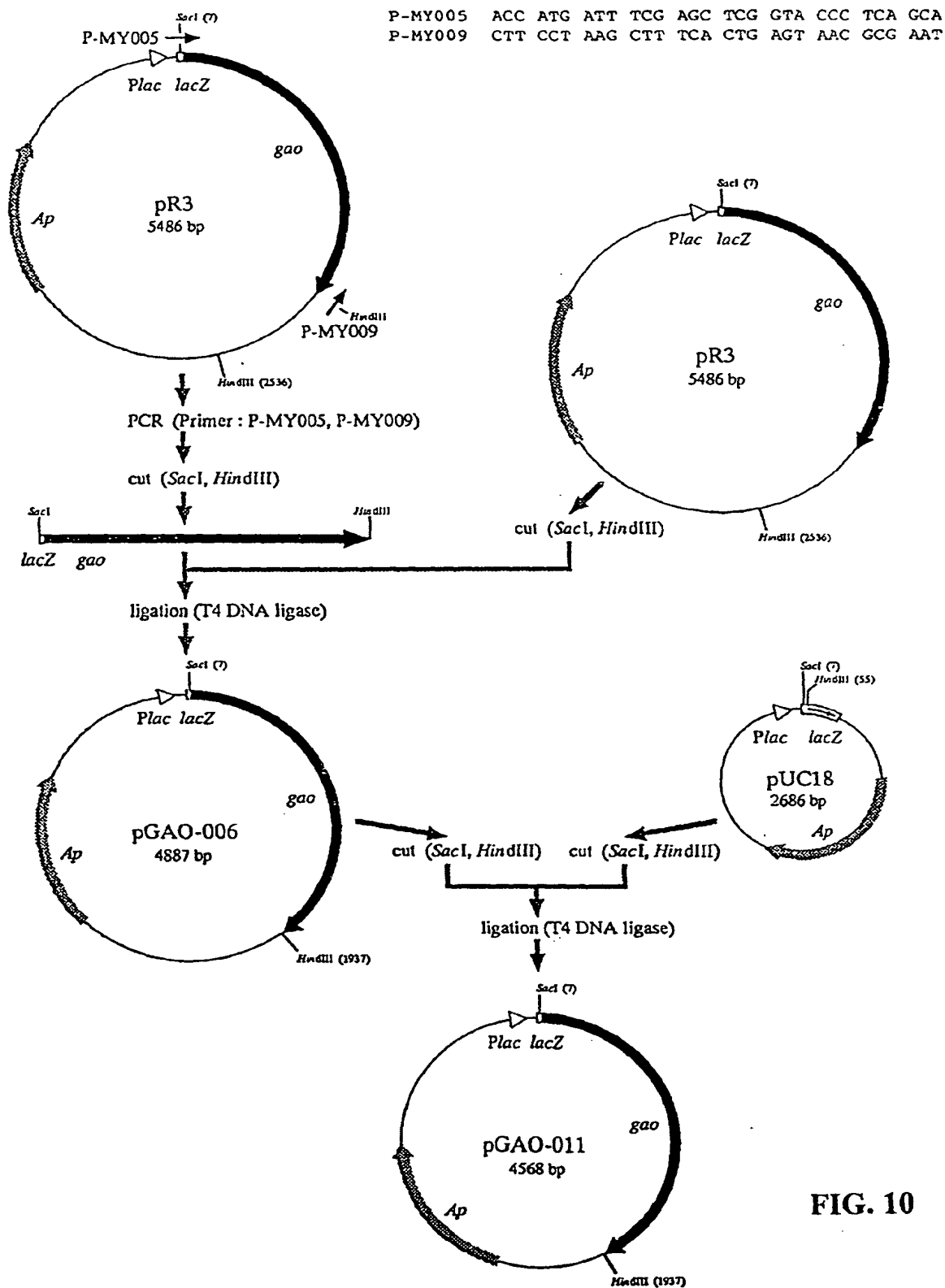


FIG. 10



FIG. 11

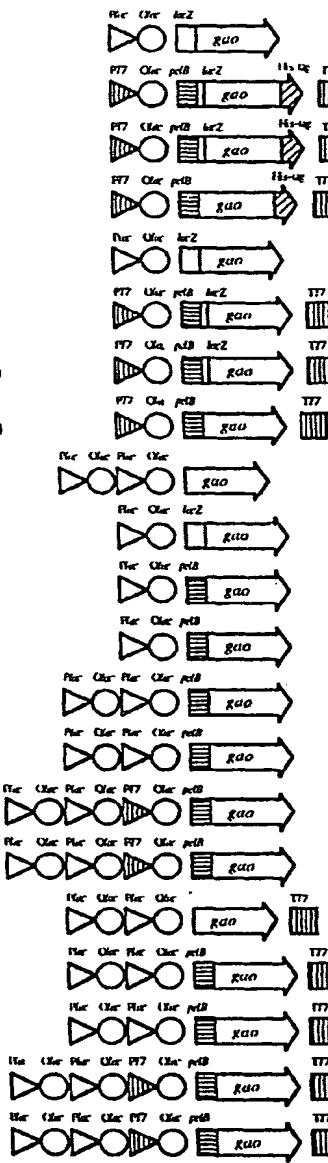
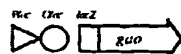
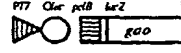
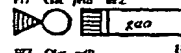

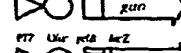
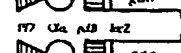
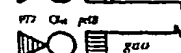
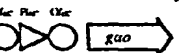
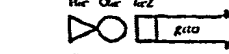


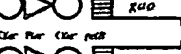
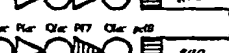
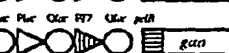
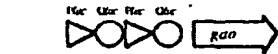
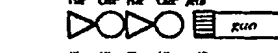
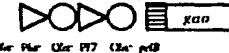
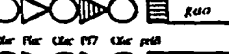



Plasmid	(vector)		GAOactivities [units/ml-culture]				
			Host strain	DH5αMCR	BL21(DE3)	KY-14478	
			Induction	-	IPTG	-	IPTG
pR3	(pUC118)		0	0.01	0.01	0.03	0.31
pGAO-003	(pET22b(+))		0	0	0	0	0
pGAO-004	(pET22b(+))		0	0	0	0	0
pGAO-005	(pET22b(+))		0	0	0	0	0
pGAO-006	(pUC118)		1.22	1.72	0.08	1.35	0.87
pGAO-007	(pET22b(+))		0.02	0	0.05	0	0
pGAO-008	(pET22b(+))		0	0	0.03	0.01	0
pGAO-009	(pET22b(+))		0	0	0.02	0.03	0
pGAO-010	(pUC18)		0	0	0.67	1.43	0.40
pGAO-011	(pUC18)		0.04	0.04	0.01	0.85	0.41
pGAO-014	(pUC18)		0	0.01	- **	- **	0
pGAO-015	(pUC18)		0	0	- **	- **	0
pGAO-016	(pUC18)		0.19	0.15	0.03	0.04	0
pGAO-017	(pUC18)		0	0	0.06	0.47	0.31
pGAO-018	(pUC18)		- *	- *	- **	- **	- **
pGAO-019	(pUC18)		- *	- *	- **	- **	- **
pGAO-020	(pUC18)		0	0.01	0.97	2.21	0.22
pGAO-021	(pUC18)		0.02	0	0.03	0.31	0.24
pGAO-022	(pUC18)		0.03	0.08	0.12	0.93	0.14
pGAO-023	(pUC18)		- *	- *	- **	- **	- *
pGAO-024	(pUC18)		- *	- *	- **	- **	- *

FIG. 12

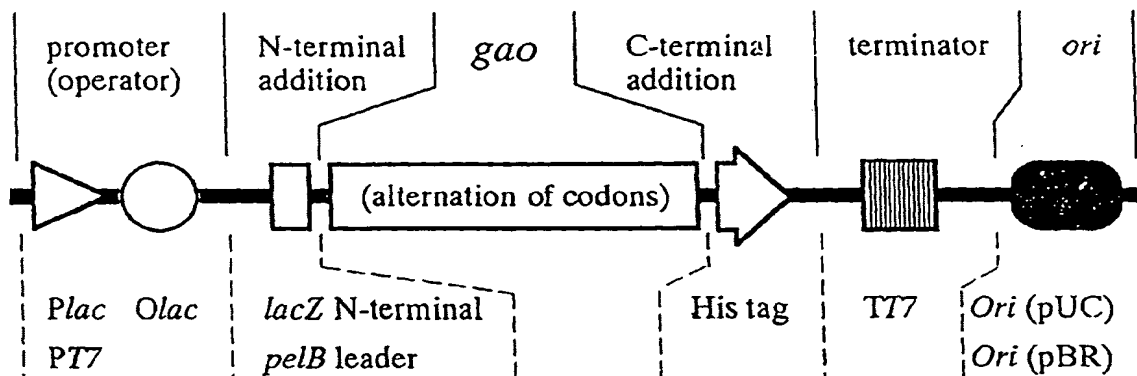


FIG. 13

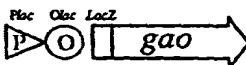
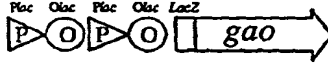



Plasmid	GAO activity [units/ml] (+ IPTG)	
	BL21(DE3)	KY-14478
pGAO-011 (pUC18)		0.28      0.74
pGAO-025 (pUC18)		0.91      0.88
pGAO-010 (pUC18)		3.32      1.20
pGAO-027 (pUC18)		3.64      1.57
pGAO-028 (pUC18)		2.97      1.77

FIG. 14

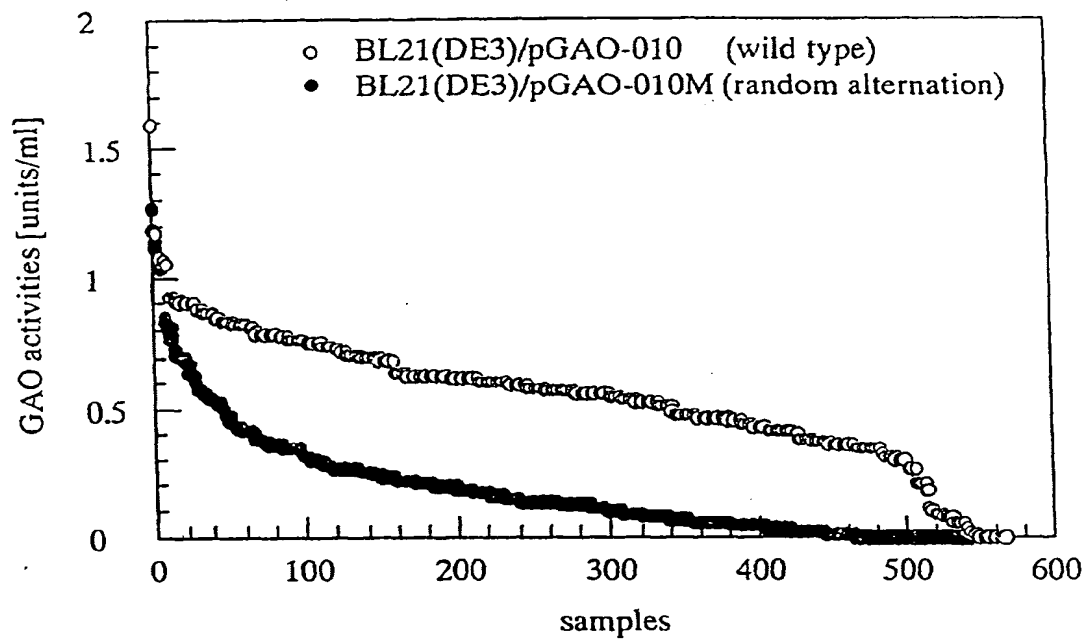
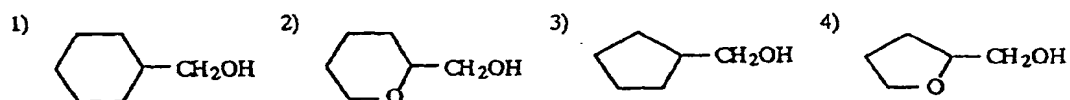


FIG. 15

Substrate (100 mM)	Rearative activities of galactose oxidase [%]	
	<i>D. dendroides</i> (Sigma)	<i>E. coli</i> BL21(DE3)/pGAO-010
D-Galactose	100	100
D-Glucose	0	0
D-Sucrose	0	0
$\alpha$ -D-Lactose	20	17
$\beta$ -D-Lactose	42	32
D-Raffinose	114	110
D-Melibiose	75	75
Benzyl alcohol (25 % Methanol)	15	11
2-Hydroxybenzyl alcohol	(+)	(+)
2-Pyridylcarbinol	14	15
3-Pyridylcarbinol	50	46
4-Pyridylcarbinol	32	29
Cyclohexylmethanol (45 % Methanol) 1)	1.9	2.1
Tetrahydropyran-2-methanol 2)	0	0
Cyclopentamethanol (30 % Methanol) 3)	0.42	0.25
Tetrahydrofurfuryl alcohol 4)	n.d.	n.d.
Glycerol	4.1	3.4
Ethylene glycol	0.45	0.16
1-Propanol	0	0
1,2-Propanediol	(+)	(+)
Acetol	13	13
Allyl alcohol	4.6	3.6



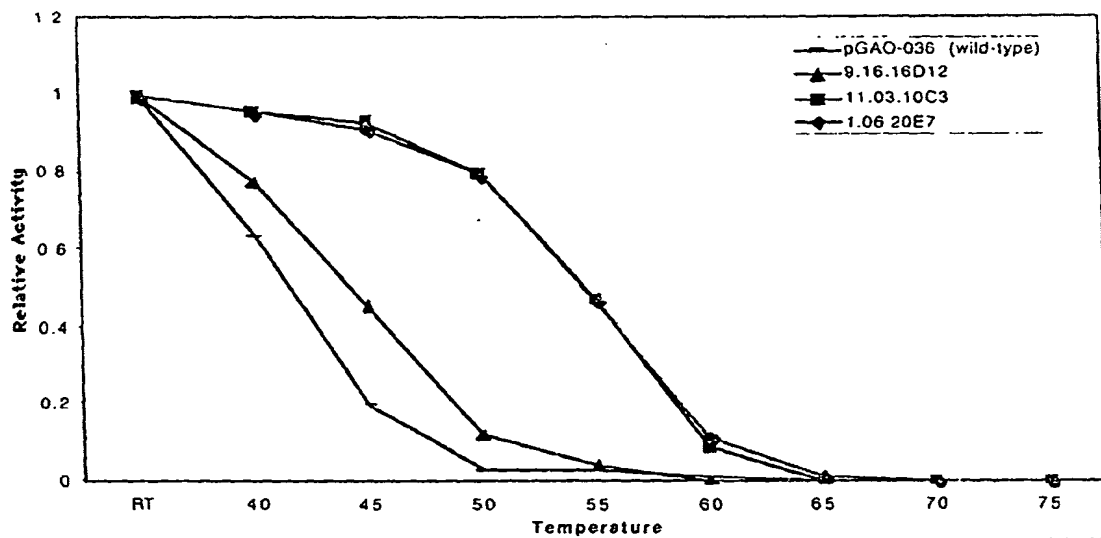


FIG. 16

Date : 2000.04.10  
Mutant ID : 9.16.8D2  
Mutation : N537D(A1609G)  
Sequence Size : 1917

FIG. 17A

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      10      20      30      40      50      60
GCC TCA GCA CCT ATC GGA AGC GCC ATT TCT CGC AAC AAC TGG GCC GTC ACT TGC GAC AGT
A S A P I G S A I S R N N W A V T C D S

      70      80      90      100      110      120
GCA CAG TCG GGA AAT GAA TGC AAC AAG GCC ATT GAT GGC AAC AAG GAT ACC TTT TGG CAC
A Q S G N E C N K A I D G N K D T F W H

      130      140      150      160      170      180
ACA TTC TAT GGC GCC AAC GGG GAT CCA AAG CCC CCT CAC ACA TAC ACG ATT GAC ATG AAG
T F Y G A N G D P K P P H T Y T I D M K

      190      200      210      220      230      240
ACA ACT CAG AAC GTC AAC GGC TTG TCT ATG CTG CCT CGA CAG GAT GGT AAC CAA AAC GGC
T T Q N V N G L S M L P R Q D G N Q N G

      250      260      270      280      290      300
TGG ATC GGT CGC CAT GAG GTT TAT CTA AGC TCA GAT GGC ACA AAC TGG GGC AGC CCT GTT
W I G R H E V Y L S S D G T N W G S P V

      310      320      330      340      350      360
GCG TCA GGT AGT TGG TTC GCC GAC TCT ACT ACA AAA TAC TCC AAC PTT GAA ACT CGC CCT
A S G S W F A D S T T K Y S N F E T R P

      370      380      390      400      410      420
GCT CGC TAT GTT CGT CTT GTC GCT ATC ACT GAA GCG AAT GGC CAG CCT TGG ACT AGC ATT
A R Y V R L V A I T E A N G Q P W T S I

      430      440      450      460      470      480
GCA GAG ATC AAC GTC TTC CAA GCT AGT TCT TAC ACA GCC CCC CAG CCT GGT CTT GGA CGC
A E I N V F Q A S S Y T A P Q P G L G R

      490      500      510      520      530      540
TGG GGT CCG ACT ATT GAC TTA CCG ATT GTT CCT GCG GCT GCA GCA ATT GAA CCG ACA TCG
W G P T I D L P I V P A A A A I E P T S

      550      560      570      580      590      600
GGA CGA GTC CTT ATG TGG TCT TCA TAT CGC AAT GAT GCA TTT GGA GGA TCC CCT GGT GGT
G R V L M W S S Y R N D A F G G S P G G

      610      620      630      640      650      660
ATC ACT TTG ACG TCT TCC TGG GAT CCA TCC ACT GGT ATT GTT TCC GAC CGC ACT GTG ACA
I T L T S S W D P S T G I V S D R T V T

      670      680      690      700      710      720
GTC ACC AAG CAT GAT ATG TTC TGC CCT GGT ATC TCC ATG GAT GGT AAC GGT CAG ATC GTA
V T K H D M F C P G I S M D G N G Q I V

      730      740      750      760      770      780
GTC ACA GGT GGC AAC GAT GCC AAG AAG ACC ACT TTG TAT GAT TCA TCT AGC GAT AGC TGG
V T G G N D A K K T S L Y D S S S D S W

      790      800      810      820      830      840
ATC CCG GGA CCT GAC ATG CAA GTG GCT CGT GGG TAT CAG TCA TCA GCT ACC ATG TCA GAC
I P G P D M Q V A R G Y Q S S A T M S D
```

FIG. 17B

850 860 870 880 890 900  
 GGT CGT GTT TTT ACC ATT GGA GGC TCC TGG AGC GGT GGC GTA TTT GAG AAG AAT GGC GAA  
 G R V F T I G G S W S G G V F E K N G E

910 920 930 940 950 960  
 GTC TAT AGC CCA TCT TCA AAG ACA TGG ACG TCC CTA CCC AAT GCC AAG GTC AAC CCA ATG  
 V Y S P S S K T W T S L P N A K V N P M

970 980 990 1000 1010 1020  
 TTG ACG GCT GAC AAG CAA GGA TTG TAC CGT TCA GAC AAC CAC GCG TGG CTC TTT GGA TGG  
 L T A D K Q G L Y R S D N H A W L F G W

1030 1040 1050 1060 1070 1080  
 AAG AAG GGT TCG GTG TTC CAA GCG GGA CCT AGC ACA GCC ATG AAC TGG TAC TAT ACC AGT  
 K K G S V F Q A G P S T A M N W Y Y T S

1090 1100 1110 1120 1130 1140  
 GGA AGT GGT GAT GTG AAG TCA GCC GGA AAA CGC CAG TCT AAC CGT GGT GTA GCC CCT GAT  
 G S G D V K S A G K R Q S N R G V A P D

1150 1160 1170 1180 1190 1200  
 GCC ATG TGC GGA AAC GCT GTC ATG TAC GAC GCC GTT AAA GGA AAG ATC CTG ACC TTT GGC  
 A M C G N A V M Y D A V K G K I L T F G

1210 1220 1230 1240 1250 1260  
 GGC TCC CCA GAT TAT CAA GAC TCT GAC GCC ACA ACC AAC GCC CAC ATC ATC ACC CTC GGT  
 G S P D Y Q D S D A T T N A H I I T L G

1270 1280 1290 1300 1310 1320  
 GAA CCC GGA ACA TCT CCC AAC ACT GTC TTT GCT AGC AAT GGG TTG TAC TTT GCC CGA ACG  
 E P G T S P N T V F A S N G L Y F A R T

1330 1340 1350 1360 1370 1380  
 TTT CAC ACC TCT GTT GTT CTT CCA GAC GGA AGC ACG TTT ATT ACA GGA GGC CAA CGA CGT  
 F H T S V V L P D G S T F I T G G Q R R

1390 1400 1410 1420 1430 1440  
 GGA ATT CCG TTC GAG GAT TCA ACC CCG GTA TTT ACA CCT GAG ATC TAC GTC CCT GAA CAA  
 G I P F E D S T P V F T P E I Y V P E Q

1450 1460 1470 1480 1490 1500  
 GAC ACT TTC TAC AAG CAG AAC CCC AAC TCC ATT GTT CGC GTC TAC CAT AGC ATT TCC CTT  
 D T F Y K Q N P N S I V R V Y H S I S L

1510 1520 1530 1540 1550 1560  
 TTG TTA CCT GAT GGC AGG GTA TTT AAC GGT GGT GGT GGT CTT TGT GGC GAT TGT ACC ACG  
 L L P D G R V F N G G G G L C G D C T T

1570 1580 1590 1600 1610 1620  
 AAT CAT TTC GAC GCG CAA ATC TTT ACG CCA AAC TAT CTT TAC AAT AGC GAC GGC AAT CTC  
 N H F D A Q I F T P N Y L Y N S D G N L

1630 1640 1650 1660 1670 1680  
 GCG ACA CGT CCC AAG ATT ACC AGA ACC TCT ACA CAG AGC GTC AAG GTC GGT GGC AGA ATT  
 A T R P K I T R T S T Q S V K V G G R I

1690 1700 1710 1720 1730 1740  
 ACA ATC TCG ACG GAT TCT TCG ATT AGC AAG GCG TCG TTG ATT CGC TAT GGT ACA GCG ACA  
 T I S T D S S I S K A S L I R Y G T A T

[illegible]



Date : 2000.04.10  
 Mutant ID : 9.16.6C11  
 Mutation : V494A(T1481C), C515S(T1543A)  
 Sequence Size : 1917

FIG. 18A

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GCC TCA GCA CCT ATC GGA AGC GCC ATT TCT CGC AAC AAC TGG GCC GTC ACT TGC GAC AGT
A  S  A  P  I  G  S  A  I  S  R  N  N  W  A  V  T  C  D  S

      70      80      90      100      110      120
GCA CAG TCG GGA AAT GAA TGC AAC AAG GCC ATT GAT GGC AAC AAG GAT ACC TTT TGG CAC
A  Q  S  G  N  E  C  N  K  A  I  D  G  N  K  D  T  F  W  H

      130      140      150      160      170      180
ACA TTC TAT GGC GCC AAC GGG GAT CCA AAG CCC CCT CAC ACA TAC ACG ATT GAC ATG AAG
T  F  Y  G  A  N  G  D  P  K  P  P  H  T  Y  T  I  D  M  K

      190      200      210      220      230      240
ACA ACT CAG AAC GTC AAC GGC TTG TCT ATG CTG CCT CGA CAG GAT GGT AAC CAA AAC GGC
T  T  Q  N  V  N  G  L  S  M  L  P  R  Q  D  G  N  Q  N  G

      250      260      270      280      290      300
TGG ATC GGT CGC CAT GAG GTT TAT CTA AGC TCA GAT GGC ACA AAC TGG GGC AGC CCT GTT
W  I  G  R  H  E  V  Y  L  S  S  D  G  T  N  W  G  S  P  V

      310      320      330      340      350      360
GCG TCA GGT AGT TGG TTC GCC GAC TCT ACT ACA AAA TAC TCC AAC TTT GAA ACT CGC CCT
A  S  G  S  W  F  A  D  S  T  T  K  Y  S  N  F  E  T  R  P

      370      380      390      400      410      420
GCT CGC TAT GTT CGT CTT GTC GCT ATC ACT GAA GCG AAT GGC CAG CCT TGG ACT AGC ATT
A  R  Y  V  R  L  V  A  I  T  E  A  N  G  Q  P  W  T  S  I

      430      440      450      460      470      480
GCA GAG ATC AAC GTC TTC CAA GCT AGT TCT TAC ACA GCC CCC CAG CCT GGT CTT GGA CGC
A  E  I  N  V  F  Q  A  S  S  Y  T  A  P  Q  P  G  L  G  R

      490      500      510      520      530      540
TGG GGT CCG ACT ATT GAC TTA CCG ATT GTT CCT GCG GCT GCA GCA ATT GAA CCG ACA TCG
W  G  P  T  I  D  L  P  I  V  P  A  A  A  A  I  E  P  T  S

      550      560      570      580      590      600
GGA CGA GTC CTT ATG TGG TCT TCA TAT CGC AAT GAT GCA TTT GGA GGA TCC CCT GGT GGT
G  R  V  L  M  W  S  S  Y  R  N  D  A  F  G  G  S  P  G  G

      610      620      630      640      650      660
ATC ACT TTG ACG TCT TCC TGG GAT CCA TCC ACT GGT ATT GTT TCC GAC CGC ACT GTG ACA
I  T  L  T  S  S  W  D  P  S  T  G  I  V  S  D  R  T  V  T

      670      680      690      700      710      720
GTC ACC AAG CAT GAT ATG TTC TGC CCT GGT ATC TCC ATG GAT GGT AAC GGT CAG ATC GTA
V  T  K  H  D  M  F  C  P  G  I  S  M  D  G  N  G  Q  I  V

      730      740      750      760      770      780
GTC ACA GGT GGC AAC GAT GCC AAG AAG ACC AGT TTG TAT GAT TCA TCT AGC GAT AGC TGG
V  T  G  G  N  D  A  K  K  T  S  L  Y  D  S  S  S  D  S  W

      790      800      810      820      830      840
ATC CCG GGA CCT GAC ATG CAA GTG GCT CGT GGG TAT CAG TCA TCA GCT ACC ATG TCA GAC
I  P  G  P  D  M  Q  V  A  R  G  Y  Q  S  S  A  T  M  S  D
  
```

FIG. 18B

850 860 870 880 890 900  
 GGT CGT GTT TTT ACC ATT GGA GGC TCC TGG AGC GGT GGC GTA TTT GAG AAG AAT GGC GAA  
 G R V F T I G G S W S G G V F E K N G E

910 920 930 940 950 960  
 GTC TAT AGC CCA TCT TCA AAG ACA TGG ACG TCC CTA CCC AAT GCC AAG GTC AAC CCA ATG  
 V Y S P S S K T W T S L P N A K V N P M

970 980 990 1000 1010 1020  
 TTG ACG GCT GAC AAG CAA GGA TTG TAC CGT TCA GAC AAC CAC GCG TGG CTC TTT GGA TGG  
 L T A D K Q G L Y R S D N H A W L F G W

1030 1040 1050 1060 1070 1080  
 AAG AAG GGT TCG GTG TTC CAA GCG GGA CCT AGC ACA GCC ATG AAC TGG TAC TAT ACC AGT  
 K K G S V F Q A G P S T A M N W Y Y T S

1090 1100 1110 1120 1130 1140  
 GGA AGT GGT GAT GTG AAG TCA GCC GGA AAA CGC CAG TCT AAC CGT GGT GTA GCC CCT GAT  
 G S G D V K S A G K R Q S N R G V A P D

1150 1160 1170 1180 1190 1200  
 GCC ATG TGC GGA AAC GCT GTC ATG TAC GAC GCC GTT AAA GGA AAG ATC CTG ACC TTT GGC  
 A M C G N A V M Y D P V K G K I L T F G

1210 1220 1230 1240 1250 1260  
 GGC TCC CCA GAT TAT CAA GAC TCT GAC GCC ACA ACC AAC GCC CAC ATC ATC ACC CTC GGT  
 G S P D Y Q D S D A T T N A H I I T L G

1270 1280 1290 1300 1310 1320  
 GAA CCC GGA ACA TCT CCC AAC ACT GTC TTT GCT AGC AAT GGG TTG TAC TTT GCC CGA ACG  
 E P G T S P N T V F A S N G L Y F A R T

1330 1340 1350 1360 1370 1380  
 TTT CAC ACC TCT GTT GTT CTT CCA GAC GGA AGC ACG TTT ATT ACA GGA GGC CAA CGA CGT  
 F H T S V V L P D G S T F I T G G Q R R

1390 1400 1410 1420 1430 1440  
 GGA ATT CCG TTC GAG GAT TCA ACC CCG GTA TTT ACA CCT GAG ATC TAC GTC CCT GAA CAA  
 G I P F E D S T P V F T P E I Y V P E Q

1450 1460 1470 1480 1490 1500  
 GAC ACT TTC TAC AAG CAG AAC CCC AAC TCC ATT GTT CGC GCC TAC CAT AGC ATT TCC CTT  
 D T F Y K Q N P N S I V R A Y H S I S L

1510 1520 1530 1540 1550 1560  
 TTG TTA CCT GAT GGC AGG GTA TTT AAC GGT GGT GGT GGT CTT AGT GGC GAT TGT ACC ACG  
 L L P D G R V F N G G G G L S G D C T T

1570 1580 1590 1600 1610 1620  
 AAT CAT TTC GAC GCG CAA ATC TTT ACG CCA AAC TAT CTT TAC AAT AGC AAC GGC AAT CTC  
 N H F D A Q I F T P N Y L Y N S N G N L

1630 1640 1650 1660 1670 1680  
 GCG ACA CGT CCC AAG ATT ACC AGA ACC TCT ACA CAG AGC GTC AAG GTC GGT GGC AGA ATT  
 A T R P K I T R T S T Q S V K V G G R I

1690 1700 1710 1720 1730 1740  
 ACA ATC TCG ACG GAT TCT TCG ATT AGC AAG GCG TCG TTG ATT CGC TAT GGT ACA GCG ACA  
 T I S T D S S I S K A S L I R Y G T A T

1750 1760 1770 1780 1790 1800  
 CAC ACG GTT AAT ACT GAC CAG CGC CGC ATT CCC CTG ACT CTG ACA AAC AAT GGA GGA AAT  
 H T V N T D Q R R I P L T L T N N G G N



Date : 2000.04.10  
 Mutant ID : 9.16.16D12  
 Mutation : P136(T408C), V494A(T1481C)  
 Sequence Size : 1917

FIG. 19A

```

      10      20      30      40      50      60
GCC TCA GCA CCT ATC GGA AGC GCC ATT TCT CGC AAC AAC TGG GCC GTC ACT TGC GAC AGT
A  S  A  P  I  G  S  A  I  S  R  N  N  W  A  V  T  C  D  S

      70      80      90      100      110      120
GCA CAG TCG GGA AAT GAA TGC AAC AAG GCC ATT GAT GGC AAC AAG GAT ACC TTT TGG CAC
A  Q  S  G  N  E  C  N  K  A  I  D  G  N  K  D  T  F  W  H

      130      140      150      160      170      180
ACA TTC TAT GGC GCC AAC GGG GAT CCA AAG CCC CCT CAC ACA TAC ACG ATT GAC ATG AAG
T  F  Y  G  A  N  G  D  P  K  P  P  H  T  Y  T  I  D  M  K

      190      200      210      220      230      240
ACA ACT CAG AAC GTC AAC GGC TTG TCT ATG CTG CCT CGA CAG GAT GGT AAC CAA AAC GGC
T  T  Q  N  V  N  G  L  S  M  L  P  R  Q  D  G  N  Q  N  G

      250      260      270      280      290      300
TGG ATC GGT CGC CAT GAG GTT TAT CTA AGC TCA GAT GGC ACA AAC TGG GGC AGC CCT GTT
W  I  G  R  H  E  V  Y  L  S  S  D  G  T  N  W  G  S  P  V

      310      320      330      340      350      360
GCG TCA GGT AGT TGG TTC GCC GAC TCT ACT ACA AAA TAC TCC AAC TTT GAA ACT CGC CCT
A  S  G  S  W  F  A  D  S  T  T  K  Y  S  N  F  E  T  R  P

      370      380      390      400      410      420
GCT CGC TAT GTT CGT CTT GTC GCT ATC ACT GAA GCG AAT GGC CAG CCC TGG ACT AGC ATT
A  R  Y  V  R  L  V  A  I  T  E  A  N  G  Q  P  W  T  S  I

      430      440      450      460      470      480
GCA GAG ATC AAC GTC TTC CAA GCT AGT TCT TAC ACA GCC CCC CAG CCT GGT CTT GGA CGC
A  E  I  N  V  F  Q  A  S  S  Y  T  A  P  Q  P  G  L  G  R

      490      500      510      520      530      540
TGG GGT CCG ACT ATT GAC TTA CCG ATT GTT CCT GCG GCT GCA GCA ATT GAA CCG ACA TCG
W  G  P  T  I  D  L  P  I  V  P  A  A  A  A  I  E  P  T  S

      550      560      570      580      590      600
GGA CGA GTC CTT ATG TGG TCT TCA TAT CGC AAT GAT GCA TTT GGA GGA TCC CCT GGT GGT
G  R  V  L  M  W  S  S  Y  R  N  D  A  F  G  G  S  P  G  G

      610      620      630      640      650      660
ATC ACT TTG ACG TCT TCC TGG GAT CCA TCC ACT GGT ATT GTT TCC GAC CGC ACT GTG ACA
I  T  L  T  S  S  W  D  P  S  T  G  I  V  S  D  R  T  V  T

      670      680      690      700      710      720
GTC ACC AAG CAT GAT ATG TTC TGC CCT GGT ATC TCC ATG GAT GGT AAC GGT CAG ATC GTA
V  T  K  H  D  M  F  C  P  G  I  S  M  D  G  N  G  Q  I  V

      730      740      750      760      770      780
GTC ACA GGT GGC AAC GAT GCC AAG AAG ACC AGT TTG TAT GAT TCA TCT AGC GAT AGC TGG
V  T  G  G  N  D  A  K  K  T  S  L  Y  D  S  S  S  D  S  W

      790      800      810      820      830      840
ATC CCG GGA CCT GAC ATG CAA GTG GCT CGT GGG TAT CAG TCA TCA GCT ACC ATG TCA GAC
I  P  G  P  D  M  Q  V  A  R  G  Y  Q  S  S  A  T  M  S  D
  
```

FIG. 19B

850 860 870 880 890 900  
 GGT CGT GTT TTT ACC ATT GGA GGC TCC TGG AGC GGT GGC GTA TTT GAG AAG AAT GGC GAA  
 G R V F T I G G S W S G G V F E K N G E

910 920 930 940 950 960  
 GTC TAT AGC CCA TCT TCA AAG ACA TGG ACG TCC CTA CCC AAT GCC AAG GTC AAC CCA ATG  
 V Y S P S S K T W T S L P N A K V N P M

970 980 990 1000 1010 1020  
 TTG ACG GCT GAC AAG CAA GGA TTG TAC CGT TCA GAC AAC CAC GCG TGG CTC TTT GGA TGG  
 L T A D K Q G L Y R S D N H A W L F G W

1030 1040 1050 1060 1070 1080  
 AAG AAG GGT TCG GTG TTC CAA GCG GGA CCT AGC ACA GCC ATG AAC TGG TAC TAT ACC AGT  
 K K G S V F Q A G P S T A M N W Y Y T S

1090 1100 1110 1120 1130 1140  
 GGA AGT GGT GAT GTG AAG TCA GCC GGA AAA CGC CAG TCT AAC CGT GGT GTA GCC CCT GAT  
 G S G D V K S A G K R Q S N R G V A P D

1150 1160 1170 1180 1190 1200  
 GCC ATG TGC GGA AAC GCT GTC ATG TAC GAC GCC GTT AAA GGA AAG ATC CTG ACC TTT GGC  
 A M C G N A V M Y D A V K G K I L T F G

1210 1220 1230 1240 1250 1260  
 GGC TCC CCA GAT TAT CAA GAC TCT GAC GCC ACA ACC AAC GCC CAC ATC ATC ACC CTC GGT  
 G S P D Y Q D S D A T T N A H I I T L G

1270 1280 1290 1300 1310 1320  
 GAA CCC GGA ACA TCT CCC AAC ACT GTC TTT GCT AGC AAT GGG TTG TAC TTT GCC CGA ACG  
 E P G T S P N T V F A S N G L Y F A R T

1330 1340 1350 1360 1370 1380  
 TTT CAC ACC TCT GTT GTT CTT CCA GAC GGA AGC ACG TTT ATT ACA GGA GGC CAA CGA CGT  
 F H T S V V L P D G S T F I T G G Q R R

1390 1400 1410 1420 1430 1440  
 GGA ATT CCG TTC GAG GAT TCA ACC CCG GTA TTT ACA CCT GAG ATC TAC GTC CCT GAA CAA  
 G I P F E D S T P V F T P E I Y V P E Q

1450 1460 1470 1480 1490 1500  
 GAC ACT TTC TAC AAG CAG AAC CCC AAC TCC ATT GTT CGC GCC TAC CAT AGC ATT TCC CTT  
 D T F Y K Q N P N S I V R A Y H S I S L

1510 1520 1530 1540 1550 1560  
 TTG TTA CCT GAT GGC AGG GTA TTT AAC GGT GGT GGT GGT CTT TGT GGC GAT TGT ACC ACG  
 L L P D G R V F N G G G L C G D C T T

1570 1580 1590 1600 1610 1620  
 AAT CAT TTC GAC GCG CAA ATC TTT ACG CCA AAC TAT CTT TAC AAT AGC AAC GGC AAT CTC  
 N H F D A Q I F T P N Y L Y N S N G N L

1630 1640 1650 1660 1670 1680  
 GCG ACA CGT CCC AAG ATT ACC AGA ACC TCT ACA CAG AGC GTC AAG GTC GGT GGC AGA ATT  
 A T R P K I T R T S T Q S V K V G G R I

1690 1700 1710 1720 1730 1740  
 ACA ATC TCG ACG GAT TCT TCG ATT AGC AAG GCG TCG TTG ATT CGC TAT GGT ACA GCG ACA  
 T I S T D S S I S K A S L I R Y G T A T

1750 1760 1770 1780 1790 1800  
 CAC ACG GTT AAT ACT GAC CAG CGC CGC ATT CCC CTG ACT CTG ACA AAC AAT GGA GGA AAT  
 H T V N T D Q R R I P L T L T N N G G N

		1810			1820			1830			1840			1850			1860		
AGC	TAT	TCT	TTC	CAA	GTT	CCT	AGC	GAC	TCT	GGT	GTT	GCT	TTG	CCT	GGC	TAC	TGG	ATG	TTG
S	Y	S	F	Q	V	P	S	D	S	G	V	A	L	P	G	Y	W	M	L
		1870			1880			1890			1900			1910			1920		
TTC	GTG	ATG	AAC	TCG	GCC	GGT	GTT	CCT	AGT	GTG	GCT	TCG	ACG	ATT	CGC	GTT	ACT	CAG	
F	V	M	N	S	A	G	V	P	S	V	A	S	T	I	R	V	T	Q	

FIG. 19C

Date : 2000.04.13  
Mutant ID : 11.03.6D3  
Mutation : S10P(T28C), P136(T408C), V494A(T1481C)  
Sequence Size : 1917

FIG. 20A

```

      10      20      30      40      50      60
GCC TCA GCA CCT ATC GGA AGC GCC ATT CCT CGC AAC AAC TGG GCC GTC ACT TGC GAC AGT
A  S  A  P  I  G  S  A  I  P  R  N  N  W  A  V  T  C  D  S

      70      80      90      100      110      120
GCA CAG TCG GGA AAT GAA TGC AAC AAG GCC ATT GAT GGC AAC AAG GAT ACC TTT TGG CAC
A  Q  S  G  N  E  C  N  K  A  I  D  G  N  K  D  T  F  W  H

      130      140      150      160      170      180
ACA TTC TAT GGC GCC AAC GGG GAT CCA AAG CCC CCT CAC ACA TAC ACG ATT GAC ATG AAG
T  F  Y  G  A  N  G  D  P  K  P  P  H  T  Y  T  I  D  M  K

      190      200      210      220      230      240
ACA ACT CAG AAC GTC AAC GGC TTG TCT ATG CTG CCT CGA CAG GAT GGT AAC CAA AAC GGC
T  T  Q  N  V  N  G  L  S  M  L  P  R  Q  D  G  N  Q  N  G

      250      260      270      280      290      300
TGG ATC GGT CGC CAT GAG GTT TAT CTA AGC TCA GAT GGC ACA AAC TGG GGC AGC CCT GTT
W  I  G  R  H  E  V  Y  L  S  S  D  G  T  N  W  G  S  P  V

      310      320      330      340      350      360
GCG TCA GGT AGT TGG TTC GCC GAC TCT ACT ACA AAA TAC TCC AAC TTT GAA ACT CGC CCT
A  S  G  S  W  F  A  D  S  T  T  K  Y  S  N  F  E  T  R  P

      370      380      390      400      410      420
GCT CGC TAT GTT CGT CTT GTC GCT ATC ACT GAA GCG AAT GGC CAG CCC TGG ACT AGC ATT
A  R  Y  V  R  L  V  A  I  T  E  A  N  G  Q  P  W  T  S  I

      430      440      450      460      470      480
GCA GAG ATC AAC GTC TTC CAA GCT AGT TCT TAC ACA GCC CCC CAG CCT GGT CTT GGA CGC
A  E  I  N  V  F  Q  A  S  S  Y  T  A  P  Q  P  G  L  G  R

      490      500      510      520      530      540
TGG GGT CCG ACT ATT GAC TTA CCG ATT GTT CCT GCG GCT GCA GCA ATT GAA CCG ACA TCG
W  G  P  T  I  D  L  P  I  V  P  A  A  A  A  I  E  P  T  S

      550      560      570      580      590      600
GGA CGA GTC CTT ATG TGG TCT TCA TAT CGC AAT GAT GCA TTT GGA GGA TCC CCT GGT GGT
G  R  V  L  M  W  S  S  Y  R  N  D  A  F  G  G  S  P  G  G

      610      620      630      640      650      660
ATC ACT TTG ACG TCT TCC TGG GAT CCA TCC ACT GGT ATT GTT TCC GAC CGC ACT GTG ACA
I  T  L  T  S  S  W  D  P  S  T  G  I  V  S  D  R  T  V  T

      670      680      690      700      710      720
GTC ACC AAG CAT GAT ATG TTC TGC CCT GGT ATC TCC ATG GAT GGT AAC GGT CAG ATC GTA
V  T  K  H  D  M  P  C  P  G  I  S  M  D  G  N  G  Q  I  V

      730      740      750      760      770      780
GTC ACA GGT GGC AAC GAT GCC AAG AAG ACC AGT TTG TAT GAT TCA TCT AGC GAT AGC TGG
V  T  G  G  N  D  A  K  K  T  S  L  Y  D  S  S  S  D  S  W

      790      800      810      820      830      840
ATC CCG GGA CCT GAC ATG CAA GTG GCT CGT GGG TAT CAG TCA TCA GCT ACC ATG TCA GAC
I  P  G  P  D  M  Q  V  A  R  G  Y  Q  S  S  A  T  M  S  D
```

FIG. 20B

850 860 870 880 890 900  
 GGT CGT GTT TTT ACC ATT GGA GGC TCC TGG AGC GGT GGC GTA TTT GAG AAG AAT GGC GAA  
 G R V F T I G G S W S G G V F E K N G E

910 920 930 940 950 960  
 GTC TAT AGC CCA TCT TCA AAG ACA TGG ACG TCC CTA CCC AAT GCC AAG GTC AAC CCA ATG  
 V Y S P S S K T W T S L P N A K V N P M

970 980 990 1000 1010 1020  
 TTG ACG GCT GAC AAG CAA GGA TTG TAC CGT TCA GAC AAC CAC GCG TGG CTC TTT GGA TGG  
 L T A D K Q G L Y R S D N H A W L F G W

1030 1040 1050 1060 1070 1080  
 AAG AAG GGT TCG GTG TTC CAA GCG GGA CCT AGC ACA GCC ATG AAC TGG TAC TAT ACC GAT  
 K K G S V F Q A G P S T A M N W Y Y T S

1090 1100 1110 1120 1130 1140  
 GGA AGT TGC GAT GTG AAG TCA GCC GGA AAA CGC CAG TCT AAC CGT GGT GTA GCC CCT GAT  
 G S G D V K S A G K R Q S N R G V A P D

1150 1160 1170 1180 1190 1200  
 GCC ATG TGC GGA AAC GCT GTC ATG TAC GAC GCC GTT AAA GGA AAG ATC CTG ACC TTT GGC  
 A M C G N A V M Y D A V K G K I L T F G

1210 1220 1230 1240 1250 1260  
 GGC TCC CCA GAT TAT CAA GAC TCT GAC GCC ACA ACC AAC GCC CAC ATC ATC ACC CTC GGT  
 G S P D Y Q D S D A T T N A H I I T L G

1270 1280 1290 1300 1310 1320  
 GAA CCC GGA ACA TCT CCC AAC ACT GTC TTT GCT AGC AAT GGG TTG TAC TTT GCC CGA ACG  
 E P G T S P N T V F A S N G L Y F A R T

1330 1340 1350 1360 1370 1380  
 TTT CAC ACC TCT GTT GTT CTI CCA GAC GGA AGC ACG TTT ATT ACA GGA GGC CAA CGA CGT  
 F H T S V V L P D G S T F I T G G Q R R

1390 1400 1410 1420 1430 1440  
 GGA ATT CCG TTC GAG GAT TCA ACC CCG GTA TTT ACA CCT GAG ATC TAC GTC CCT GAA CAA  
 G I P F E D S T P V F T P E I Y V P E Q

1450 1460 1470 1480 1490 1500  
 GAC ACT TTC TAC AAG CAG AAC CCC AAC TCC ATT GTT CGC GCC TAC CAT AGC ATT TCC CTT  
 D T F Y K Q N P N S I V R A Y H S I S L

1510 1520 1530 1540 1550 1560  
 TTG TTA CCT GAT GGC AGG GTA TTT AAC GGT GGT GGT GGT CTT TGT GGC GAT TGT ACC ACG  
 L L P D G R V F N G G G G L C G D C T T

1570 1580 1590 1600 1610 1620  
 AAT CAT TTC GAC GCG CAA ATC TTT ACG CCA AAC TAT CTT TAC AAT AGC AAC GGC AAT CTC  
 N H F D A Q I F T P N Y L Y N S N G N L

1630 1640 1650 1660 1670 1680  
 GCG ACA CGT CCC AAG ATT ACC AGA ACC TCT ACA CAG AGC GTC AAG GTC GGT GGC AGA ATT  
 A T R P K I T R T S T Q S V K V G G R I

1690 1700 1710 1720 1730 1740  
 ACA ATC TCG ACG GAT TCT TCG ATT AGC AAG GCG TCG TTG ATT CGC TAT GGT ACA GCG ACA  
 T I S T D S S I S K A S L I R Y G T A T

1750 1760 1770 1780 1790 1800  
 CAC ACG GTT AAT ACT GAC CAG CGC CGC ATT CCC CTG ACT CTG ACA AAC AAT GGA GGA AAT  
 H T V N T D Q R R I P L T L T N N G G N



	1810		1820		1830		1840		1850		1860								
AGC	TAT	TCT	TTC	CAA	GTT	CCT	AGC	GAC	TCT	GGT	GTT	GCT	TTG	CCT	GGC	TAC	TGG	ATG	TTG
S	Y	S	F	Q	V	P	S	D	S	G	V	A	L	P	G	Y	W	M	L
	1870		1880		1890		1900		1910		1920								
TTC	GTG	ATG	AAC	TCG	GCC	GGT	GTT	CCT	AGT	GTG	GCT	TCG	ACG	ATT	CGC	GTT	ACT	CAG	
F	V	M	N	S	A	G	V	P	S	V	A	S	T	I	R	V	T	Q	

FIG. 20C

Date : 2000.04.10  
Mutant ID : 11.03.10C3  
Mutation : A3(A9C), P136(T408C), G195E(G584A), V494A(T1481C)  
Sequence Size : 1917

FIG. 21A

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      10      20      30      40      50      60
GCC TCA GCC CCT ATC GGA AGC GCC ATT TCT CGC AAC AAC TGG GCC GTC ACT TGC GAC AGT
A  S  A  P  I  G  S  A  I  S  R  N  N  W  A  V  T  C  D  S

      70      80      90      100      110      120
GCA CAG TCG GGA AAT GAA TGC AAC AAG GCC ATT GAT GGC AAC AAG GAT ACC TTT TGG CAC
A  Q  S  G  N  E  C  N  K  A  I  D  G  N  K  D  T  F  W  H

      130      140      150      160      170      180
ACA TTC TAT GGC GCC AAC GGG GAT CCA AAG CCC CCT CAC ACA TAC ACG ATT GAC ATG AAG
T  F  Y  G  A  N  G  D  P  K  P  P  H  T  Y  T  I  D  M  K

      190      200      210      220      230      240
ACA ACT CAG AAC GTC AAC GGC TTG TCT ATG CTG CCT CGA CAG GAT GGT AAC CAA AAC GGC
T  T  Q  N  V  N  G  L  S  M  L  P  R  Q  D  G  N  Q  N  G

      250      260      270      280      290      300
TGG ATC GGT CGC CAT GAG GTT TAT CTA AGC TCA GAT GGC ACA AAC TGG GGC AGC CCT GTT
W  I  G  R  H  E  V  Y  L  S  S  D  G  T  N  W  G  S  P  V

      310      320      330      340      350      360
GCG TCA GGT AGT TGG TTC GCC GAC TCT ACT ACA AAA TAC TCC AAC TTT GAA ACT CGC CCT
A  S  G  S  W  F  A  D  S  T  T  K  Y  S  N  F  E  T  R  P

      370      380      390      400      410      420
GCT CGC TAT GTT CGT CTT GTC GCT ATC ACT GAA GCG AAT GGC CAG CCC TGG ACT AGC ATT
A  R  Y  V  R  L  V  A  I  T  E  A  N  G  Q  P  W  T  S  I

      430      440      450      460      470      480
GCA GAG ATC AAC GTC TTC CAA GCT AGT TCT TAC ACA GCC CCC CAG CCT GGT CTT GGA CGC
A  E  I  N  V  F  Q  A  S  S  Y  T  A  P  Q  P  G  L  G  R

      490      500      510      520      530      540
TGG GGT CCG ACT ATT GAC TTA CCG ATT GTT CCT GCG GCT GCA GCA ATT GAA CCG ACA TCG
W  G  P  T  I  D  L  P  I  V  P  A  A  A  A  I  E  P  T  S

      550      560      570      580      590      600
GGA CGA GTC CTT ATG TGG TCT TCA TAT CGC AAT GAT GCA TTT GAA GGA TCC CCT GGT GGT
G  R  V  L  M  W  S  S  Y  R  N  D  A  F  E  G  S  P  G  G

      610      620      630      640      650      660
ATC ACT TTG ACG TCT TCC TGG GAT CCA TCC ACT GGT ATT GTT TCC GAC CGC ACT GTG ACA
I  T  L  T  S  S  W  D  P  S  T  G  I  V  S  D  R  T  V  T

      670      680      690      700      710      720
GTC ACC AAG CAT GAT ATG TTC TGC CCT GGT ATC TCC ATG GAT GGT AAC GGT CAG ATC GTA
V  T  K  H  D  M  F  C  P  G  I  S  M  D  G  N  G  Q  I  V

      730      740      750      760      770      780
GTC ACA GGT GGC AAC GAT GCC AAG AAG ACC AGT TTG TAT GAT TCA TCT AGC GAT AGC TGG
V  T  G  G  N  D  A  K  K  T  S  L  Y  D  S  S  S  D  S  W

      790      800      810      820      830      840
ATC CCG GGA CCT GAC ATG CAA GTG GCT CGT GGG TAT CAG TCA TCA GCT ACC ATG TCA GAC
I  P  G  P  D  M  Q  V  A  R  G  Y  Q  S  S  A  T  M  S  D
```

FIG. 21B

850 860 870 880 890 900  
 GGT CGT GTT TTT ACC ATT GGA GGC TCC TGG AGC GGT GGC GTA TTT GAG AAG AAT GGC GAA  
 G R V F T I G G S W S G G V F E K N G E

910 920 930 940 950 960  
 GTC TAT AGC CCA TCT TCA AAG ACA TGG ACG TCC CTA CCC AAT GCC AAG GTC AAC CCA ATG  
 V Y S P S S K T W T S L P N A K V N P M

970 980 990 1000 1010 1020  
 TTG ACG GCT GAC AAG CAA GGA TTG TAC CGT TCA GAC AAC CAC GCG TGG CTC TTT GGA TGG  
 L T A D K Q G L Y R S D N H A W L F G W

1030 1040 1050 1060 1070 1080  
 AAG AAG GGT TCG GTG TTC CAA GCG GGA CCT AGC ACA GCC ATG AAC TGG TAC TAT ACC AGT  
 K K G S V F Q A G P S T A M N W Y Y T S

1090 1100 1110 1120 1130 1140  
 GGA AGT GGT GAT GTG AAG TCA GCC GGA AAA CGC CAG TCT AAC CGT GGT GTA GCC CCT GAT  
 G S G D V K S A G K R Q S N R G V A P D

1150 1160 1170 1180 1190 1200  
 GCC ATG TGC GGA AAC GCT GTC ATG TAC GAC GCC GTT AAA GGA AAG ATC CTG ACC TTT GGC  
 A M C G N A V M Y D A V K G K I L T F G

1210 1220 1230 1240 1250 1260  
 GGC TCC CCA GAT TAT CAA GAC TCT GAC GCC ACA ACC AAC GCC CAC ATC ATC ACC CTC GGT  
 G S P D Y Q D S D A T T N A H I I T L G

1270 1280 1290 1300 1310 1320  
 GAA CCC GGA ACA TCT CCC AAC ACT GTC TTT GCT AGC AAT GGG TTG TAC TTT GCC CGA ACG  
 E P G T S P N T V F A S N G L Y F A R T

1330 1340 1350 1360 1370 1380  
 TTT CAC ACC TCT GTT GTT CTT CCA GAC GGA AGC ACG TTT ATT ACA GGA GGC CAA CGA CGT  
 F H T S V V L P D G S T F I T G G Q R R

1390 1400 1410 1420 1430 1440  
 GGA ATT CCG TTC GAG GAT TCA ACC CCG GTA TTT ACA CCT GAG ATC TAC GTC CCT GAA CAA  
 G I P F E D S T P V F T P E I Y V P E Q

1450 1460 1470 1480 1490 1500  
 GAC ACT TTC TAC AAG CAG AAC CCC AAC TCC ATT GTT CGC GCC TAC CAT AGC ATT TCC CTT  
 D T F Y K Q N P N S I V R A Y H S I S L

1510 1520 1530 1540 1550 1560  
 TTG TTA CCT GAT GGC AGG GTA TTT AAC GGT GGT GGT GGT CTT TGT GGC GAT TGT ACC ACG  
 L L P D G R V F N G G G G L C G D C T T

1570 1580 1590 1600 1610 1620  
 AAT CAT TTC GAC GCG CAA ATC TTT ACG CCA AAC TAT CTT TAC AAT AGC AAC GGC AAT CTC  
 N H F D A Q I F T P N Y L Y N S N G N L

1630 1640 1650 1660 1670 1680  
 GCG ACA CGT CCC AAG ATT ACC AGA ACC TCT ACA CAG AGC GTC AAG GTC GGT GGC AGA ATT  
 A T R P K I T R T S T Q S V K V G G R I

1690 1700 1710 1720 1730 1740  
 ACA ATC TCG ACG GAT TCT TCG ATT AGC AAG GCG TCG TTG ATT CGC TAT GGT ACA GCG ACA  
 T I S T D S S I S K A S L I R Y G T A T

1750 1760 1770 1780 1790 1800  
 CAC ACG GTT AAT ACT GAC CAG CGC CGC ATT CCC CTG ACT CTG ACA AAC AAT GGA GGA AAT  
 H T V N T D Q R R I P L T L T N N G G N

		1810			1820			1830			1840			1850			1860
AGC	TAT	TCT	TTC	CAA	GTT	CCT	AGC	GAC	TCT	GGT	GTT	GCT	TTG	CCT	GGC	TAC	TGG
S	Y	S	F	Q	V	P	S	D	S	G	V	A	L	P	G	Y	W
		1870			1880			1890			1900			1910			1920
TTC	GTG	ATG	AAC	TCG	GCC	GGT	GTT	CCT	AGT	GTG	GCT	TCG	ACG	ATT	CGC	GTT	ACT
F	V	M	N	S	A	G	V	P	S	V	A	S	T	I	R	V	T
																	Q

FIG. 21C

FIG. 22A

Date : 2000.04.10  
 Mutant ID : 11.03.10D6  
 Mutation : P136(T408C), T218(T654C), L312(A936G), V494A(T1481C), N535D(A1603G)  
 Sequence Size : 1917

```

      10      20      30      40      50      60
GCC TCA GCA CCT ATC GGA AGC GCC ATT TCT CGC AAC AAC TGG GCC GTC ACT TGC GAC AGT
A  S  A  P  I  G  S  A  I  S  R  N  N  W  A  V  T  C  D  S

      70      80      90     100     110     120
GCA CAG TCG GGA AAT GAA TGC AAC AAG GCC ATT GAT GGC AAC AAG GAT ACC TTT TGG CAC
A  Q  S  G  N  E  C  N  K  A  I  D  G  N  K  D  T  F  W  H

     130     140     150     160     170     180
ACA TTC TAT GGC GCC AAC GGG GAT CCA AAG CCC CCT CAC ACA TAC ACG ATT GAC ATG AAG
T  F  Y  G  A  N  G  D  P  K  P  P  H  T  Y  T  I  D  M  K

     190     200     210     220     230     240
ACA ACT CAG AAC GTC AAC GGC TTG TCT ATG CTG CCT CGA CAG GAT GGT AAC CAA AAC GGC
T  T  Q  N  V  N  G  L  S  M  L  P  R  Q  D  G  N  Q  N  G

     250     260     270     280     290     300
TGG ATC GGT CGC CAT GAG GTT TAT CTA AGC TCA GAT GGC ACA AAC TGG GGC AGC CCT GTT
W  I  G  R  H  E  V  Y  L  S  S  D  G  T  N  W  G  S  P  V

     310     320     330     340     350     360
GCG TCA GGT AGT TGG TTC GCC GAC TCT ACT ACA AAA TAC TCC AAC TTT GAA ACT CGC CCT
A  S  G  S  W  F  A  D  S  T  T  K  Y  S  N  F  E  T  R  P

     370     380     390     400     410     420
GCT CGC TAT GTT CGT CTT GTC GCT ATC ACT GAA GCG AAT GGC CAG CCC TGG ACT AGC ATT
A  R  Y  V  R  L  V  A  I  T  E  A  N  G  Q  P  W  T  S  I

     430     440     450     460     470     480
GCA GAG ATC AAC GTC TTC CAA GCT AGT TCT TAC ACA GCC CCC CAG CCT GGT CTT GGA CGC
A  E  I  N  V  F  Q  A  S  S  Y  T  A  P  Q  P  G  L  G  R

     490     500     510     520     530     540
TGG GGT CCG ACT ATT GAC TTA CCG ATT GTT CCT GCG GCT GCA GCA ATT GAA CCG ACA TCG
W  G  P  T  I  D  L  P  I  V  P  A  A  A  A  I  E  P  T  S

     550     560     570     580     590     600
GGA CGA GTC CTT ATG TGG TCT TCA TAT CGC AAT GAT GCA TTT GGA GGA TCC CCT GGT GGT
G  R  V  L  M  W  S  S  Y  R  N  D  A  F  G  G  S  P  G  G

     610     620     630     640     650     660
ATC ACT TTG ACG TCT TCC TGG GAT CCA TCC ACT GGT ATT GTT TCC GAC CGC ACC GTG ACA
I  T  L  T  S  S  W  D  P  S  T  G  I  V  S  D  R  T  V  T

     670     680     690     700     710     720
GTC ACC AAG CAT GAT ATG TTC TGC CCT GGT ATC TCC ATG GAT GGT AAC GGT CAG ATC GTA
V  T  K  H  D  M  F  C  P  G  I  S  M  D  G  N  G  Q  I  V

     730     740     750     760     770     780
GTC ACA GGT GGC AAC GAT GCC AAG AAG ACC AGT TTG TAT GAT TCA TCT AGC GAT AGC TGG
V  T  G  G  N  D  A  K  K  T  S  L  Y  D  S  S  S  D  S  W

     790     800     810     820     830     840
ATC CCG GGA CCT GAC ATG CAA GTG GCT CGT GGG TAT CAG TCA TCA GCT ACC ATG TCA GAC
I  P  G  P  D  M  Q  V  A  R  G  Y  Q  S  S  A  T  M  S  D
  
```

FIG. 22B

850 860 870 880 890 900  
 GGT CGT GTT TTT ACC ATT GGA GGC TCC TGG AGC GGT GGC GTA TTT GAG AAG AAT GGC GAA  
 G R V F T I G G S W S G G V F E K N G E

910 920 930 940 950 960  
 GTC TAT AGC CCA TCT TCA AAG ACA TGG ACG TCC CTG CCC AAT GCC AAG GTC AAC CCA ATG  
 V Y S P S S K T W T S L P N A K V N P M

970 980 990 1000 1010 1020  
 TTG ACG GCT GAC AAG CAA GGA TTG TAC CGT TCA GAC AAC CAC GCG TGG CTC TTT GGA TGG  
 L T A D K Q G L Y R S D N H A W L F G W

1030 1040 1050 1060 1070 1080  
 AAG AAG GGT TCG GTG TTC CAA GCG GGA CCT AGC ACA GCC ATG AAC TGG TAC TAT ACC AGT  
 K K G S V F Q A G P S T A M N W Y Y T S

1090 1100 1110 1120 1130 1140  
 GGA AGT GGT GAT GTG AAG TCA GCC GGA AAA CGC CAG TCT AAC CGT GGT GTA GCC CCT GAT  
 G S G D V K S A G K R Q S N R G V A P D

1150 1160 1170 1180 1190 1200  
 GCC ATG TGC GGA AAC GCT GTC ATG TAC GAC GCC GTT AAA GGA AAG ATC CTG ACC TTT GGC  
 A M C G N A V M Y D A V K G K I L T F G

1210 1220 1230 1240 1250 1260  
 GGC TCC CCA GAT TAT CAA GAC TCT GAC GCC ACA ACC AAC GCC CAC ATC ATC ACC CTC GGT  
 G S P D Y Q D S D A T T N A H I I T L G

1270 1280 1290 1300 1310 1320  
 GAA CCC GGA ACA TCT CCC AAC ACT GTC TTT GCT AGC AAT GGG TTG TAC TTT GCC CGA ACG  
 E P G T S P N T V F A S N G L Y F A R T

1330 1340 1350 1360 1370 1380  
 TTT CAC ACC TCT GTT GTT CTT CCA GAC GGA AGC ACG TTT ATT ACA GGA GGC CAA CGA CGT  
 F H T S V V L P D G S T F I T G G Q R R

1390 1400 1410 1420 1430 1440  
 GGA ATT CCG TTC GAG GAT TCA ACC CCG GTA TTT ACA CCT GAG ATC TAC GTC CCT GAA CAA  
 G I P F E D S T P V F T P E I Y V P E Q

1450 1460 1470 1480 1490 1500  
 GAC ACT TTC TAC AAG CAG AAC CCC AAC TCC ATT GTT CGC GCC TAC CAT AGC ATT TCC CTT  
 D T F Y K Q N P N S I V R A Y H S I S L

1510 1520 1530 1540 1550 1560  
 TTG TTA CCT GAT GGC AGG GTA TTT AAC GGT GGT GGT GGT CTT TGT GGC GAT TGT ACC ACG  
 L L P D G R V F N G G G L C G D C T T

1570 1580 1590 1600 1610 1620  
 AAT CAT TTC GAC GCG CAA ATC TTT ACG CCA AAC TAT CTT TAC GAT AGC AAC GGC AAT CTC  
 N H F D A Q I F T P N Y L Y D S N G N L

1630 1640 1650 1660 1670 1680  
 GCG ACA CGT CCC AAG ATT ACC AGA ACC TCT ACA CAG AGC GTC AAG GTC GGT GGC AGA ATT  
 A T R P K I T R T S T Q S V K V G G R I

1690 1700 1710 1720 1730 1740  
 ACA ATC TCG ACG GAT TCT TCG ATT AGC AAG GCG TCG TTG ATT CGC TAT GGT ACA GCG ACA  
 T I S T D S S I S K A S L I R Y G T A T

1750 1760 1770 1780 1790 1800  
 CAC ACG GTT AAT ACT GAC CAG CGC CGC ATT CCC CTG ACT CTG ACA AAC AAT GGA GGA AAT  
 H T V N T D Q R R I P L T L T N N G G N

1810	1820	1830	1840	1850	1860
AGC TAT TCT TTC CAA GTT CCT AGC GAC TCT GGT GTT GCT TTG CCT GGC TAC TGG ATG TTG					
S Y S F Q V P S D S G V A L P G Y W M L					
1870	1880	1890	1900	1910	1920
TTC GTG ATG AAC TCG GCC GGT GTT CCT AGT GTG GCT TCG ACG ATT CGC GTT ACT CAG					
F V M N S A G V P S V A S T I R V T Q					

FIG. 22C

1810  
 1820  
 1830  
 1840  
 1850  
 1860  
 1870  
 1880  
 1890  
 1900  
 1910  
 1920

Date : 2000.04.10  
 Mutan ID : 11.03.13E12  
 Mutation : M70V(A208G), P136(T408C), V494A(T1481C)  
 Sequence Size : 1917

FIG. 23A

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      10      20      30      40      50      60
GCC TCA GCA CCT ATC GGA AGC GCC ATT TCT CGC AAC AAC TGG GCC GTC ACT TGC GAC AGT
A  S  A  P  I  G  S  A  I  S  R  N  N  W  A  V  T  C  D  S

      70      80      90      100      110      120
GCA CAG TCG GGA AAT GAA TGC AAC AAG GCC ATT GAT GGC AAC AAG GAT ACC TTT TGG CAC
A  Q  S  G  N  E  C  N  K  A  I  D  G  N  K  D  T  F  W  H

      130      140      150      160      170      180
ACA TTC TAT GGC GCC AAC GGG GAT CCA AAG CCC CCT CAC ACA TAC ACG ATT GAC ATG AAG
T  F  Y  G  A  N  G  D  P  K  P  P  H  T  Y  T  I  D  M  K

      190      200      210      220      230      240
ACA ACT CAG AAC GTC AAC GGC TTG TCT GTG CTG CCT CGA CAG GAT GGT AAC CAA AAC GGC
T  T  Q  N  V  N  G  L  S  V  L  P  R  Q  D  G  N  Q  N  G

      250      260      270      280      290      300
TGG ATC GGT CGC CAT GAG GTT TAT CTA AGC TCA GAT GGC ACA AAC TGG GGC AGC CCT GTT
W  I  G  R  H  E  V  Y  L  S  S  D  G  T  N  W  G  S  P  V

      310      320      330      340      350      360
GCG TCA GGT AGT TGG TTC GCC GAC TCT ACT ACA AAA TAC TCC AAC TTT GAA ACT CGC CCT
A  S  G  S  W  F  A  D  S  T  T  K  Y  S  N  F  E  T  R  P

      370      380      390      400      410      420
GCT CGC TAT GTT CGT CTT GTC GCT ATC ACT GAA GCG AAT GGC CAG CCC TGG ACT AGC ATT
A  R  Y  V  R  L  V  A  I  T  E  A  N  G  Q  P  W  T  S  I

      430      440      450      460      470      480
GCA GAG ATC AAC GTC TTC CAA GCT AGT TCT TAC ACA GCC CCC CAG CCT GGT CTT GGA CGC
A  E  I  N  V  F  Q  A  S  S  Y  T  A  P  Q  P  G  L  G  R

      490      500      510      520      530      540
TGG GGT CCG ACT ATT GAC TTA CCG ATT GTT CCT GCG GCT GCA GCA ATT GAA CCG ACA TCG
W  G  P  T  I  D  L  P  I  V  P  A  A  A  A  I  E  P  T  S

      550      560      570      580      590      600
GGA CGA GTC CTT ATG TGG TCT TCA TAT CGC AAT GAT GCA TTT GGA GGA TCC CCT GGT GGT
G  R  V  L  M  W  S  S  Y  R  N  D  A  F  G  G  S  P  G  G

      610      620      630      640      650      660
ATC ACT TTG ACG TCT TCC TGG GAT CCA TCC ACT GGT ATT GTT TCC GAC CGC ACT GTG ACA
I  T  L  T  S  S  W  D  P  S  T  G  I  V  S  D  R  T  V  T

      670      680      690      700      710      720
GTC ACC AAG CAT GAT ATG TTC TGC CCT GGT ATC TCC ATG GAT GGT AAC GGT CAG ATC GTA
V  T  K  H  D  M  F  C  P  G  I  S  M  D  G  N  G  Q  I  V

      730      740      750      760      770      780
GTC ACA GGT GGC AAC GAT GCC AAG AAG ACC AGT TTG TAT GAT TCA TCT AGC GAT AGC TGG
V  T  G  G  N  D  A  K  K  T  S  L  Y  D  S  S  S  D  S  W

      790      800      810      820      830      840
ATC CCG GGA CCT GAC ATG CAA GTG GCT CGT GGG TAT CAG TCA TCA GCT ACC ATG TCA GAC
I  P  G  P  D  M  Q  V  A  R  G  Y  Q  S  S  A  T  M  S  D

```



FIG. 23B

850 860 870 880 890 900  
 GGT CGT GTT TTT ACC ATT GGA GGC TCC TGG AGC GGT GGC GTA TTT GAG AAG AAT GGC GAA  
 G R V F T I G G S W S G G V F E K N G E

910 920 930 940 950 960  
 GTC TAT AGC CCA TCT TCA AAG ACA TGG ACG TCC CTA CCC AAT GCC AAG GTC AAC CCA ATG  
 V Y S P S S K T W T S L P N A K V N P M

970 980 990 1000 1010 1020  
 TTG ACG GCT GAC AAG CAA GGA TTG TAC CGT TCA GAC AAC CAC GCG TGG CTC TTT GGA TGG  
 L T A D K Q G L Y R S D N H A W L F G W

1030 1040 1050 1060 1070 1080  
 AAG AAG GGT TCG GTG TTC CAA GCG GGA CCT AGC ACA GCC ATG AAC TGG TAC TAT ACC AGT  
 K K G S V F Q A G P S T A M N W Y Y T S

1090 1100 1110 1120 1130 1140  
 GGA AGT GGT GAT GTG AAG TCA GCC GGA AAA CGC CAG TCT AAC CGT GGT GTA GCC CCT GAT  
 G S G D V K S A G K R Q S N R G V A P D

1150 1160 1170 1180 1190 1200  
 GCC ATG TGC GGA AAC GCT GTC ATG TAC GAC GCC GTT AAA GGA AAG ATC CTG ACC TTT GGC  
 A M C G N A V M Y D A V K G K I L T F G

1210 1220 1230 1240 1250 1260  
 GGC TCC CCA GAT TAT CAA GAC TCT GAC GCC ACA ACC AAC GCC CAC ATC ATC ACC CTC GGT  
 G S P D Y Q D S D A T T N A H I I T L G

1270 1280 1290 1300 1310 1320  
 GAA CCC GGA ACA TCT CCC AAC ACT GTC TTT GCT AGC AAT GGG TTG TAC TTT GCC CGA ACG  
 E P G T S P N T V F A S N G L Y F A R T

1330 1340 1350 1360 1370 1380  
 TTT CAC ACC TCT CTT GTT CTT CCA GAC GGA AGC ACG TTT ATT ACA GGA GGC CAA CGA CGT  
 F H T S V V L P D G S T F I T G G Q R R

1390 1400 1410 1420 1430 1440  
 GGA ATT CCG TTC GAG GAT TCA ACC CCG GTA TTT ACA CCT GAG ATC TAC GTC CCT GAA CAA  
 G I P F E D S T P V F T P E I Y V P E Q

1450 1460 1470 1480 1490 1500  
 GAC ACT TTC TAC AAG CAG AAC CCC AAC TCC ATT GTT CGC GCC TAC CAT AGC ATT TCC CTT  
 D T F Y K Q N P N S I V R A Y H S I S L

1510 1520 1530 1540 1550 1560  
 TTG TTA CCT GAT GGC AGG GTA TTT AAC GGT GGT GGT CTT TGT GGC GAT TGT ACC ACG  
 L L P D G R V F N G G G L C G D C T T

1570 1580 1590 1600 1610 1620  
 AAT CAT TTC GAC GCG CAA ATC TTT ACG CCA AAC TAT CTT TAC AAT AGC AAC GGC AAT CTC  
 N H F D A Q I F T P N Y L Y N S N G N L

1630 1640 1650 1660 1670 1680  
 GCG ACA CGT CCC AAG ATT ACC AGA ACC TCT ACA CAG AGC GTC AAG GTC GGT GGC AGA ATT  
 A T R P K I T R T S T Q S V K V G G R I

1690 1700 1710 1720 1730 1740  
 ACA ATC TCG ACG GAT TCT TCG ATT AGC AAG GCG TCG TTG ATT CGC TAT GGT ACA GCG ACA  
 T I S T D S S I S K A S L I R Y G T A T

1750 1760 1770 1780 1790 1800  
 CAC ACG GTT AAT ACT GAC CAG CGC CGC ATT CCC CTG ACT CTG ACA AAC AAT GGA GGA AAT  
 H T V N T D Q R R I P L T L T N N G G N

1810	1820	1830	1840	1850	1860
AGC TAT TCT TTC CAA GTT CCT	AGC GAC TCT GGT GTT GCT TTG CCT	GGC TAC TGG ATG TTG			
S Y S F Q V P S D S G V A L P G Y W M L					
1870	1880	1890	1900	1910	1920
TTC GTG ATG AAC TCG GCC GGT GTT CCT AGT GTG GCT TCG ACG ATT CGC GTT ACT CAG					
F V M N S A G V P S V A S T I R V T Q					

FIG. 23C

FIG. 24A

Date : 2000.04.10  
 Filename : 1.06.20E7  
 Mutation : S10P(T28C), M70V(A208G), P136(T408C), G195E(G584A), V494A(T1481C)  
 N535D(A1603G)  
 Sequence Size : 1917

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      10      20      30      40      50      60
GCC TCA GCA CCT ATC GGA AGC GCC ATT CCT CGC AAC AAC TGG GCC GTC ACT TGC GAC AGT
A  S  A  P  I  G  S  A  I  P  R  N  N  W  A  V  T  C  D  S

      70      80      90      100     110     120
GCA CAG TCG GGA AAT GAA TGC AAC AAG GCC ATT GAT GGC AAC AAG GAT ACC TTT TGG CAC
A  Q  S  G  N  E  C  N  K  A  I  D  G  N  K  D  T  F  W  H

     130     140     150     160     170     180
ACA TTC TAT GGC GCC AAC GGG GAT CCA AAG CCC CCT CAC ACA TAC ACG ATT GAC ATG AAG
T  F  Y  G  A  N  G  D  P  K  P  P  H  T  Y  T  I  D  M  K

     190     200     210     220     230     240
ACA ACT CAG AAC GTC AAC GGC TTG TCT GTG CTG CCT CGA CAG GAT GGT AAC CAA AAC GGC
T  T  Q  N  V  N  G  L  S  V  L  P  R  Q  D  G  N  Q  N  G

     250     260     270     280     290     300
TGG ATC GGT CGC CAT GAG GTT TAT CTA AGC TCA GAT GGC ACA AAC TGG GGC AGC CCT GTT
W  I  G  R  H  E  V  Y  L  S  S  D  G  T  N  W  G  S  P  V

     310     320     330     340     350     360
GCG TCA GGT AGT TGG TTC GCC GAC TCT ACT ACA AAA TAC TCC AAC TTT GAA ACT CGC CCT
A  S  G  S  W  F  A  D  S  T  T  K  Y  S  N  F  E  T  R  P

     370     380     390     400     410     420
GCT CGC TAT GTT CGT CTT GTC GCT ATC ACT GAA GCG AAT GGC CAG CCC TGG ACT AGC ATT
A  R  Y  V  R  L  V  A  I  T  E  A  N  G  Q  P  W  T  S  I

     430     440     450     460     470     480
GCA GAG ATC AAC GTC TTC CAA GCT AGT TCT TAC ACA GCC CCC CAG CCT GGT CTT GGA CGC
A  E  I  N  V  F  Q  A  S  S  Y  T  A  P  Q  P  G  L  G  R

     490     500     510     520     530     540
TGG GGT CCG ACT ATT GAC TTA CCG ATT GTT CCT GCG GCT GCA GCA ATT GAA CCG ACA TCG
W  G  P  T  I  D  L  P  I  V  P  A  A  A  A  I  E  P  T  S

     550     560     570     580     590     600
GGA CGA GTC CTT ATG TGG TCT TCA TAT CGC AAT GAT GCA TTT GAA GGA TCC CCT GGT GGT
G  R  V  L  M  W  S  S  Y  R  N  D  A  F  E  G  S  P  G  G

     610     620     630     640     650     660
ATC ACT TTG ACG TCT TCC TGG GAT CCA TCC ACT GGT ATT GTT TCC GAC CGC ACT GTG ACA
I  T  L  T  S  S  W  D  P  S  T  G  I  V  S  D  R  T  V  T

     670     680     690     700     710     720
GTC ACC AAG CAT GAT ATG TTC TGC CCT GGT ATC TCC ATG GAT GGT AAC GGT CAG ATC GTA
V  T  K  H  D  M  F  C  P  G  I  S  M  D  G  N  G  Q  I  V

     730     740     750     760     770     780
GTC ACA GGT GGC AAC GAT GCC AAG AAG ACC AGT TTG TAT GAT TCA TCT AGC GAT AGC TGG
V  T  G  G  N  D  A  K  K  T  S  L  Y  D  S  S  S  D  S  W

     790     800     810     820     830     840
ATC CCG GGA CCT GAC ATG CAA GTG GCT CGT GGG TAT CAG TCA TCA GCT ACC ATG TCA GAC
I  P  G  P  D  M  Q  V  A  R  G  Y  Q  S  S  A  T  M  S  D
  
```

FIG. 24B

850 860 870 880 890 900  
 GGT CGT GTT TTT ACC ATT GGA GGC TCC TGG AGC GGT GGC GTA TTT GAG AAG AAT GGC GAA  
 G R V F T I G G S W S G G V F E K N G E

910 920 930 940 950 960  
 GTC TAT AGC CCA TCT TCA AAG ACA TGG ACG TCC CTA CCC AAT GCC AAG GTC AAC CCA ATG  
 V Y S P S S K T W T S L P N A K V N P M

970 980 990 1000 1010 1020  
 TTG ACG GCT GAC AAG CAA GGA TTG TAC CGT TCA GAC AAC CAC GCG TGG CTC TTT GGA TGG  
 L T A D K Q G L Y R S D N H A W L F G W

1030 1040 1050 1060 1070 1080  
 AAG AAG GGT TCG GTG TTC CAA GCG GGA CCT AGC ACA GCC ATG AAC TGG TAC TAT ACC AGT  
 K K G S V F Q A G P S T A M N W Y Y T S

1090 1100 1110 1120 1130 1140  
 GGA AGT GGT GAT GTG AAG TCA GCC GGA AAA CGC CAG TCT AAC CGT GGT GTA GCC CCT GAT  
 G S G D V K S A G K R Q S N R G V A P D

1150 1160 1170 1180 1190 1200  
 GCC ATG TGC GGA AAC GCT GTC ATG TAC GAC GCC GTT AAA GGA AAG ATC CTG ACC TTT GGC  
 A M C G N A V M Y D A V K G K I L T F G

1210 1220 1230 1240 1250 1260  
 GGC TCC CCA GAT TAT CAA GAC TCT GAC GCC ACA ACC AAC GCC CAC ATC ATC ACC CTC GGT  
 G S P D Y Q D S D A T T N A H I I T L G

1270 1280 1290 1300 1310 1320  
 GAA CCC GGA ACA TCT CCC AAC ACT GTC TTT GCT AGC AAT GGG TTG TAC TTT GCC CGA ACG  
 E P G T S P N T V F A S N G L Y F A R T

1330 1340 1350 1360 1370 1380  
 TTT CAC ACC TCT GTT GTT CTT CCA GAC GGA AGC ACG TTT ATT ACA GGA GGC CAA CGA CGT  
 F H T S V V L P D G S T F I T G G Q R R

1390 1400 1410 1420 1430 1440  
 GGA ATT CCG TTC GAG GAT TCA ACC CCG GTA TTT ACA CCT GAG ATC TAC GTC CCT GAA CAA  
 G I P F E D S T P V F T P E I Y V P E Q

1450 1460 1470 1480 1490 1500  
 GAC ACT TTC TAC AAG CAG AAC CCC AAC TCC ATT GTT CGC GCC TAC CAT AGC ATT TCC CTT  
 D T F Y K Q N P N S I V R A Y H S I S L

1510 1520 1530 1540 1550 1560  
 TTG TTA CCT GAT GGC AGG GTA TTT AAC GGT GGT GGT GGT CTT TGT GGC GAT TGT ACC ACG  
 L L P D G R V F N G G G G L C G D C T T

1570 1580 1590 1600 1610 1620  
 AAT CAT TTC GAC GCG CAA ATC TTT ACG CCA AAC TAT CTT TAC GAT AGC AAC GGC AAT CTC  
 N H F D A Q I F T P N Y L Y D S N G N L

1630 1640 1650 1660 1670 1680  
 GCG ACA CGT CCC AAG ATT ACC AGA ACC TCT ACA CAG AGC GTC AAG GTC GGT GGC AGA ATT  
 A T R P K I T R T S T Q S V K V G G R I

1690 1700 1710 1720 1730 1740  
 ACA ATC TCG ACG GAT TCT TCG ATT AGC AAG GCG TCG TTG ATT CGC TAT GGT ACA GCG ACA  
 T I S T D S S I S K A S L I R Y G T A T

1750 1760 1770 1780 1790 1800  
 CAC ACG GTT AAT ACT GAC CAG CGC CGC ATT CCC CTG ACT CTG ACA AAC AAT GGA GGA AAT  
 H T V N T D Q R R I P L T L T N N G G N

		1810			1820			1830			1840			1850			1860		
AGC	TAT	TCT	TTC	CAA	GTT	CCT	AGC	GAC	TCT	GGT	GTT	GCT	TTG	CCT	GGC	TAC	TGG	ATG	TTG
S	Y	S	F	Q	V	P	S	D	S	G	V	A	L	P	G	Y	W	M	L

		1870			1880			1890			1900			1910			1920	
TTC	GTG	ATG	AAC	TCG	GCC	GGT	GTT	CCT	AGT	GTG	GCT	TCG	ACG	ATT	CGC	GTT	ACT	CAG
F	V	M	N	S	A	G	V	P	S	V	A	S	T	I	R	V	T	Q

FIG. 24C

Date : 2000.04.11  
Mutant ID : 1.D4  
Mutation : N413D(A1237G)  
Sequence Size : 1917

## FIG. 25A

```

      10      20      30      40      50      60
GCC TCA GCA CCT ATC GGA AGC GCC ATT TCT CGC AAC AAC TGG GCC GTC ACT TGC GAC AGT
A S A P I G S A I S R N N W A V T C D S

      70      80      90     100     110     120
GCA CAG TCG GGA AAT GAA TGC AAC AAG GCC ATT GAT GGC AAC AAG GAT ACC TTT TGG CAC
A Q S G N E C N K A I D G N K D T F W H

      130     140     150     160     170     180
ACA TTC TAT GGC GCC AAC GGG GAT CCA AAG CCC CCT CAC ACA TAC ACG ATT GAC ATG AAT
T F Y G A N G D P K P P H T Y T I D M K

      190     200     210     220     230     240
ACA ACT CAG AAC GTC AAC GGC TTG TCT ATG CTG CCT CGA CAG GAT GGT AAC CAA AAC GGC
T T Q N V N G L S M L P R Q D G N Q N G

      250     260     270     280     290     300
TGG ATC GGT CGC CAT GAG GTT TAT CTA AGC TCA GAT GGC ACA AAC TGG GGC AGC CCT GTT
W I G R H E V Y L S S D G T N W G S P V

      310     320     330     340     350     360
GCG TCA GGT AGT TGG TTC GCC GAC TCT ACT ACA AAA TAC TCC AAC TTT GAA ACT CGC CCT
A S G S W F A D S T T K Y S N F E T R P

      370     380     390     400     410     420
GCT CGC TAT GTT CGT CTT GTC GCT ATC ACT GAA GCG AAT GGC CAG CCT TGG ACT AGC ATT
A R Y V R L V A I T E A N G Q P W T S I

      430     440     450     460     470     480
GCA GAG ATC AAC GTC TTC CAA GCT AGT TCT TAC ACA GCC CCC CAG CCT GGT CTT GCA CGC
A E I N V F Q A S S Y T A P Q P G L G R

      490     500     510     520     530     540
TGG GGT CCG ACT ATT GAC TTA CCG ATT GTT CCT GCG GCT GCA GCA ATT GAA CCG ACA TCG
W G P T I D L P I V P A A A A I E P T S

      550     560     570     580     590     600
GGA CGA GTC CTT ATG TGG TCT TCA TAT CGC AAT GAT GCA TTT GGA GGA TCC CCT GGT GGT
G R V L M W S S Y R N D A F G G S P G G

      610     620     630     640     650     660
ATC ACT TTG ACG TCT TCC TGG GAT CCA TCC ACT GGT ATT GTT TCC GAC CGC ACT GTG ACA
I T L T S S W D P S T G I V S D R T V T

      670     680     690     700     710     720
GTC ACC AAG CAT GAT ATG TTC TGC CCT GGT ATC TCC ATG GAT GGT AAC GGT CAG ATC GTA
V T K H D M F C P G I S M D G N G Q I V

      730     740     750     760     770     780
GTC ACA GGT GGC AAC GAT GCC AAG AAG ACC AGT TTG TAT GAT TCA TCT AGC GAT AGC TGG
V T G G N D A K K T S L Y D S S S D S W

      790     800     810     820     830     840
ATC CCG GGA CCT GAC ATG CAA GTG GCT CGT GGG TAT CAG TCA TCA GCT ACC ATG TCA GAC
I P G P D M Q V A R G Y Q S S A T M S D
```

FIG. 25B

850 860 870 880 890 900  
 GGT CGT GTT TTT ACC ATT GGA GGC TCC TGG AGC GGT GGC GTA TTT GAG AAG AAT GGC GAA  
 G R V F T I G G S W S G G V F E K N G E

910 920 930 940 950 960  
 GTC TAT AGC CCA TCT TCA AAG ACA TGG ACG TCC CTA CCC AAT GCC AAG GTC AAC CCA ATG  
 V Y S P S S K T W T S L P N A K V N P M

970 980 990 1000 1010 1020  
 TTG ACG GCT GAC AAG CAA GGA TTG TAC CGT TCA GAC AAC CAC GCG TGG CTC TTT GGA TGG  
 L T A D K Q G L Y R S D N H A W L F G W

1030 1040 1050 1060 1070 1080  
 AAG AAG GGT TCG GTG TTC CAA GCG GGA CCT AGC ACA GCC ATG AAC TGG TAC TAT ACC AGT  
 K K G S V F Q A G P S T A M N W Y Y T S

1090 1100 1110 1120 1130 1140  
 GGA AGT GGT GAT GTG AAG TCA GCC GGA AAA CGC CAG TCT AAC CGT GGT GTA GCC CCT GAT  
 G S G D V K S A G K R Q S N R G V A P D

1150 1160 1170 1180 1190 1200  
 GCC ATG TGC GGA AAC GCT GTC ATG TAC GAC GCC GTT AAA GGA AAG ATC CTG ACC TTT GGC  
 A M C G N A V M Y D A V K G K I L T F G

1210 1220 1230 1240 1250 1260  
 GGC TCC CCA GAT TAT CAA GAC TCT GAC GCC ACA ACC GAC GCC CAC ATC ATC ACC CTC GGT  
 G S P D Y Q D S D A T T D A H I I T L G

1270 1280 1290 1300 1310 1320  
 GAA CCC GGA ACA TCT CCC AAC ACT GTC TTT GCT AGC AAT GGG TTG TAC TTT GCC CGA ACG  
 E P G T S P N T V F A S N G L Y F A R T

1330 1340 1350 1360 1370 1380  
 TTT CAC ACC TCT GTT GTT CTT CCA GAC GGA AGC ACG TTT ATT ACA GGA GGC CAA CGA CGT  
 F H T S V V L P D G S T F I T G G Q R R

1390 1400 1410 1420 1430 1440  
 GGA ATT CCG TTC GAG GAT TCA ACC CCG GTA TTT ACA CCT GAG ATC TAC GTC CCT GAA CAA  
 G I P F E D S T P V F T P E I Y V P E Q

1450 1460 1470 1480 1490 1500  
 GAC ACT TTC TAC AAG CAG AAC CCC AAC TCC ATT GTT CGC GTC TAC CAT AGC ATT TCC CTT  
 D T F Y K Q N P N S I V R V Y H S I S L

1510 1520 1530 1540 1550 1560  
 TTG TTA CCT GAT GGC AGG GTA TTT AAC GGT GGT GGT GGT CTT TGT GGC GAT TGT ACC ACG  
 L L P D G R V F N G G G G L C G D C T T

1570 1580 1590 1600 1610 1620  
 AAT CAT TTC GAC GCG CAA ATC TTT ACG CCA AAC TAT CTT TAC AAT AGC AAC GGC AAT CTC  
 N H F D A Q I F T P N Y L Y N S N G N L

1630 1640 1650 1660 1670 1680  
 GCG ACA CGT CCC AAG ATT ACC AGA ACC TCT ACA CAG AGC GTC AAG GTC GGT GGC AGA ATT  
 A T R P K I T R T S T Q S V K V G G R I

1690 1700 1710 1720 1730 1740  
 ACA ATC TCG ACG GAT TCT TCG ATT AGC AAG GCG TCG TTG ATT CGC TAT GGT ACA GCG ACA  
 T I S T D S S I S K A S L I R Y G T A T

1750 1760 1770 1780 1790 1800  
 CAC ACG GTT AAT ACT GAC CAG CGC CGC ATT CCC CTG ACT CTG ACA AAC AAT GGA GGA AAT  
 H T V N T D Q R R I P L T L T N N G G N

		1810			1820			1830			1840			1850		1860			
AGC	TAT	TCT	TTC	CAA	GTT	CCT	AGC	GAC	TCT	GGT	GTT	GCT	TTG	CCT	GGC	TAC	TGG	ATG	TTG
S	Y	S	F	Q	V	P	S	D	S	G	V	A	L	P	G	Y	W	M	L
		1870			1880			1890			1900			1910		1920			
TTC	GTG	ATG	AAC	TCG	GCC	GGT	GTT	CCT	AGT	GTG	GCT	TCG	ACG	ATT	CGC	GTT	ACT	CAG	
F	V	M	N	S	A	G	V	P	S	V	A	S	T	I	R	V	T	Q	

FIG. 25C

2025 RELEASE UNDER E.O. 14176



Date : 2000.04 11  
Mutant ID : 2.G4  
Mutation : N413D(A1237G),S550(T1650A)  
Sequence Size : 1917

FIG. 26A

```

      10      20      30      40      50      60
GCC TCA GCA CCT ATC GGA AGC GCC ATT TCT CGC AAC AAC TGG GCC GTC ACT TGC GAC AGT
A  S  A  P  I  G  S  A  I  S  R  N  N  W  A  V  T  C  D  S

      70      80      90     100     110     120
GCA CAG TCG GGA AAT GAA TGC AAC AAG GCC ATT GAT GGC AAC AAG GAT ACC TTT TGG CAC
A  Q  S  G  N  E  C  N  K  A  I  D  G  N  K  D  T  F  W  H

      130     140     150     160     170     180
ACA TTC TAT GGC GCC AAC GGG GAT CCA AAG CCC CCT CAC ACA TAC ACG ATT GAC ATG AAG
T  F  Y  G  A  N  G  D  P  K  P  P  H  T  Y  T  I  D  M  K

      190     200     210     220     230     240
ACA ACT CAG AAC GTC AAC GGC TTG TCT ACT CTG CCT CGA CAG GAT GGT AAC CAA AAC GGC
T  T  Q  N  V  N  G  L  S  M  L  P  R  Q  D  G  N  Q  N  G

      250     260     270     280     290     300
TGG ATC GGT CGC CAT GAG GTT TAT CTA AGC TCA GAT GGC ACA AAC TGG GGC AGC CCT GTT
W  I  G  R  H  E  V  Y  L  S  S  D  G  T  N  W  G  S  P  V

      310     320     330     340     350     360
GCG TCA GGT AGT TGG TTC GCC GAC TCT ACT ACA AAA TAC TCC AAC TTT GAA ACT CGC GCT
A  S  G  S  W  F  A  D  S  T  T  K  Y  S  N  F  E  T  R  P

      370     380     390     400     410     420
GCT CGC TAT GTT CGT CTT GTC GCT ATC ACT GAA GCG AAT GGC CAG CCT TGG ACT AGC ATT
A  R  Y  V  R  L  V  A  I  T  E  A  N  G  Q  P  W  T  S  I

      430     440     450     460     470     480
GCA GAG ATC AAC GTC TTC CAA GCT AGT TCT TAC ACA GCC CCC CAG CCT GGT CTT GGA CGC
A  E  I  N  V  F  Q  A  S  S  Y  T  A  P  Q  P  G  L  G  R

      490     500     510     520     530     540
TGG GGT CCG ACT ATT GAC TTA CCG ATT GTT CCT GCG GCT GCA GCA ATT GAA CCG ACA TCG
W  G  P  T  I  D  L  P  I  V  P  A  A  A  A  I  E  P  T  S

      550     560     570     580     590     600
GGA CGA GTC CTT ATG TGG TCT TCA TAT CGC AAT GAT GCA TTT GGA GGA TCC CCT GGT GGT
G  R  V  L  M  W  S  S  Y  R  N  D  A  F  G  G  S  P  G  G

      610     620     630     640     650     660
ATC ACT TTG ACG TCT TCC TGG GAT CCA TCC ACT GGT ATT GTT TCC GAC CGC ACT GTG ACA
I  T  L  T  S  S  W  D  P  S  T  G  I  V  S  D  R  T  V  T

      670     680     690     700     710     720
GTC ACC AAG CAT GAT ATG TTC TGC CCT GGT ATC TCC ATG GAT GGT AAC GGT CAG ATC GTA
V  T  K  H  D  M  F  C  P  G  I  S  M  D  G  N  G  Q  I  V

      730     740     750     760     770     780
GTC ACA GGT GGC AAC GAT GCC AAG AAG ACC AGT TTG TAT GAT TCA TCT AGC GAT AGC TGG
V  T  G  G  N  D  A  K  K  T  S  L  Y  D  S  S  S  D  S  W

      790     800     810     820     830     840
ATC CCG GGA CCT GAC ATG CAA GTG GCT CGT GGG TAT CAG TCA TCA GCT ACC ATG TCA GAC
I  P  G  P  D  M  Q  V  A  R  G  Y  Q  S  S  A  T  M  S  D
```

FIG. 26B

850 860 870 880 890 900  
 GGT CGT GTT TTT ACC ATT GGA GGC TCC TGG AGC GGT GGC GTA TTT GAG AAG AAT GGC GAA  
 G R V F T I G G S W S G G V F E K N G E

910 920 930 940 950 960  
 GTC TAT AGC CCA TCT TCA AAG ACA TGG ACG TCC CTA CCC AAT GCC AAG GTC AAC CCA ATG  
 V Y S P S S K T W T S L P N A K V N P M

970 980 990 1000 1010 1020  
 TTG ACG GCT GAC AAG CAA GGA TTG TAC CGT TCA GAC AAC CAC GCG TGG CTC TTT GGA TGG  
 L T A D K Q G L Y R S D N H A W L F G W

1030 1040 1050 1060 1070 1080  
 AAG AAG GGT TCG GTG TTC CAA GCG GGA CCT AGC ACA GCC ATG AAC TGG TAC TAT ACC AGT  
 K K G S V F Q A G P S T A M N W Y Y T S

1090 1100 1110 1120 1130 1140  
 GGA AGT GGT GAT GTG AAG TCA GCC GGA AAA CGC CAG TCT AAC CGT GGT GTA GCC CCT GAT  
 G S G D V K S A G K R Q S N R G V A P D

1150 1160 1170 1180 1190 1200  
 GCC ATG TGC GGA AAC GCT GTC ATG TAC GAC GCC GTT AAA GGA AAG ATC CTG ACC TTT GGC  
 A M C G N A V M Y D A V K G K I L T F G

1210 1220 1230 1240 1250 1260  
 GGC TCC CCA GAT TAT CAA GAC TCT GAC GCC ACA ACC GAC GCC CAC ATC ATC ACC CTC GGT  
 G S P D Y Q D S D A T T D A H I I T L G

1270 1280 1290 1300 1310 1320  
 GAA CCC GGA ACA TCT CCC AAC ACT GTC TTT GCT AGC AAT GGG TTG TAC TTT GCC CGA ACG  
 E P G T S P N T V F A S N G L Y F A R T

1330 1340 1350 1360 1370 1380  
 TTT CAC ACC TCT GTT GTT CTT CCA GAC GGA AGC ACG TTT ATT ACA GGA GGC CAA CGA CGT  
 F H T S V V L P D G S T F I T G G Q R R

1390 1400 1410 1420 1430 1440  
 GGA ATT CCG TTC GAG GAT TCA ACC CCG GTA TTT ACA CCT GAG ATC TAC GTC CCT GAA CAA  
 G I P F E D S T P V F T P E I Y V P E Q

1450 1460 1470 1480 1490 1500  
 GAC ACT TTC TAC AAG CAG AAC CCC AAC TCC ATT GTT CGC GTC TAC CAT AGC ATT TCC CTT  
 D T F Y K Q N P N S I V R V Y H S I S L

1510 1520 1530 1540 1550 1560  
 TTG TTA CCT GAT GGC AGG GTA TTT AAC GGT GGT GGT GGT CTT TGT GGC GAT TGT ACC ACG  
 L L P D G R V F N G G G G L C G D C T T

1570 1580 1590 1600 1610 1620  
 AAT CAT TTC GAC GCG CAA ATC TTT ACG CCA AAC TAT CTT TAC AAT AGC AAC GGC AAT CTC  
 N H F D A Q I F T P N Y L Y N S N G N L

1630 1640 1650 1660 1670 1680  
 GCG ACA CGT CCC AAG ATT ACC AGA ACC TCA ACA CAG AGC GTC AAG GTC GGT GGC AGA ATT  
 A T R P K I T R T S T Q S V K V G G R I

1690 1700 1710 1720 1730 1740  
 ACA ATC TCG ACG GAT TCT TCG ATT AGC AAG GCG TCG TTG ATT CGC TAT GGT ACA GCG ACA  
 T I S T D S S I S K A S L I R Y G T A T

1750 1760 1770 1780 1790 1800  
 CAC ACG GTT AAT ACT GAC CAG CGC CGC ATT CCC CTG ACT CTG ACA AAC AAT GGA GGA AAT  
 H T V N T D Q R R I P L T L T N N G G N



FIG. 27A

Date : 2000 04.11  
 Mutant ID : J.H7  
 Mutation : N413D(A1237G), S550(T1650A), V494A(T1481C)  
 Sequence Size : 1917

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      10      20      30      40      50      60
GCC TCA GCA CCT ATC GGA AGC GCC ATT TCT CGC AAC AAC TGG GCC GTC ACT TGC GAC AGT
A  S  A  P  I  G  S  A  I  S  R  N  N  W  A  V  T  C  D  S

      70      80      90      100     110     120
GCA CAG TCG GGA AAT GAA TGC AAC AAG GCC ATT GAT GGC AAC AAG GAT ACC TTT TGG CAC
A  Q  S  G  N  E  C  N  K  A  I  D  G  N  K  D  T  F  W  H

      130     140     150     160     170     180
ACA TTC TAT GGC GCC AAC GGG GAT CCA AAG CCC CCT CAC ACA TAC ACG ATT GAC ATG AAG
T  F  Y  G  A  N  G  D  P  K  P  P  H  T  Y  T  I  D  M  K

      190     200     210     220     230     240
ACA ACT CAG AAC GTC AAC GGC TTG TCT ATG CTG CCT CGA CAG GAT GGT AAC CAA AAC GGC
T  T  Q  N  V  N  G  L  S  M  L  P  R  Q  D  G  N  Q  N  G

      250     260     270     280     290     300
TGG ATC GGT CGC CAT GAG GTT TAT CTA AGC TCA GAT GGC ACA AAC TGG GGC AGC CCT GTT
W  I  G  R  H  E  V  Y  L  S  S  D  G  T  N  W  G  S  P  V

      310     320     330     340     350     360
GCG TCA GGT AGT TGG TTC GCC GAC TCT ACT ACA AAA TAC TCC AAC TTT GAA ACT CGC CCT
A  S  G  S  W  F  A  D  S  T  T  K  Y  S  N  F  E  T  R  P

      370     380     390     400     410     420
GCT CGC TAT GTT CGT CTT GTC GCT ATC ACT GAA GCG AAT GGC CAG CCT TGG ACT AGC ATT
A  R  Y  V  R  L  V  A  I  T  E  A  N  G  Q  P  W  T  S  I

      430     440     450     460     470     480
GCA GAG ATC AAC GTC TTC CAA GCT AGT TCT TAC ACA GCC CCC CAG CCT GGT CTT GGA CGC
A  E  I  N  V  F  Q  A  S  S  Y  T  A  P  Q  P  G  L  G  R

      490     500     510     520     530     540
TGG GGT CCG ACT ATT GAC TTA CCG ATT GTT CCT GCG GCT GCA GCA ATT GAA CCG ACA TCG
W  G  P  T  I  D  L  P  I  V  P  A  A  A  I  E  P  T  S

      550     560     570     580     590     600
GGA CGA GTC CTT ATG TGG TCT TCA TAT CGC AAT GAT GCA TTT GGA GGA TCC CCT GGT GGT
G  R  V  L  M  W  S  S  Y  R  N  D  A  F  G  G  S  P  G  G

      610     620     630     640     650     660
ATC ACT TTG ACG TCT TCC TGG GAT CCA TCC ACT GGT ATT GTT TCC GAC CGC ACT GTG ACA
I  T  L  T  S  S  W  D  P  S  T  G  I  V  S  D  R  T  V  T

      670     680     690     700     710     720
GTC ACC AAG CAT GAT ATG TTC TGC CCT GGT ATC TCC ATG GAT GGT AAC GGT CAG ATC GTA
V  T  K  H  D  M  F  C  P  G  I  S  M  D  G  N  G  Q  I  V

      730     740     750     760     770     780
GTC ACA GGT GGC AAC GAT GCC AAG AAG ACC AGT TTG TAT GAT TCA TCT AGC GAT AGC TGG
V  T  G  G  N  D  A  K  K  T  S  L  Y  D  S  S  S  D  S  W

      790     800     810     820     830     840
ATC CCG GGA CCT GAC ATG CAA GTG GCT CGT GGG TAT CAG TCA TCA GCT ACC ATG TCA GAC
I  P  G  P  D  M  Q  V  A  R  G  Y  Q  S  S  A  T  M  S  D

```

FIG. 27B

850 860 870 880 890 900  
 GGT CGT GTT TTT ACC ATT GGA GGC TCC TGG AGC GGT GGC GTA TTT GAG AAG AAT GGC GAA  
 G R V F T I G G S W S G G V F E K N G E

910 920 930 940 950 960  
 GTC TAT AGC CCA TCT TCA AAG ACA TGG ACG TCC CTA CCC AAT GCC AAG GTC AAC CCA ATG  
 V Y S P S S K T W T S L P N A K V N P M

970 980 990 1000 1010 1020  
 TTG ACG GCT GAC AAG CAA GGA TTG TAC CGT TCA GAC AAC CAC GCG TGG CTC TTT GGA TGG  
 L T A D K Q G L Y R S D N H A W L F G W

1030 1040 1050 1060 1070 1080  
 AAG AAG GGT TCG GTG TTC CAA GCG GGA CCT AGC ACA GCC ATG AAC TGG TAC TAT ACC AGT  
 K K G S V F Q A G P S T A M N W Y Y T S

1090 1100 1110 1120 1130 1140  
 GGA AGT GGT GAT GTG AAG TCA GCC GGA AAA CGC CAG TCT AAC CGT GGT GTA GCC CCT GAT  
 G S G D V K S A G K R Q S N R G V A P D

1150 1160 1170 1180 1190 1200  
 GCC ATG TGC GGA AAC GCT GTC ATG TAC GAC GCC GTT AAA GGA AAG ATC CTG ACC TTT GGC  
 A M C G N A V M Y D A V K G K I L T F G

1210 1220 1230 1240 1250 1260  
 GGC TCC CCA GAT TAT CAA GAC TCT GAC GCC ACA ACC GAC GCC CAC ATC ATC ACC CTC GGT  
 G S P D Y Q D S D A T T D A H I I T L G

1270 1280 1290 1300 1310 1320  
 GAA CCC GGA ACA TCT CCC AAC ACT GTC TTT GCT AGC AAT GGG TTG TAC TTT GCC CGA ACG  
 E P G T S P N T V F A S N G L Y F A R T

1330 1340 1350 1360 1370 1380  
 TTT CAC ACC TCT GTT GTT CTT CCA GAC GGA AGC ACG TTT ATT ACA GGA GGC CAA CGA CGT  
 F H T S V V L P D G S T F I T G G Q R R

1390 1400 1410 1420 1430 1440  
 GGA ATT CCG TTC GAG GAT TCA ACC CCG GTA TTT ACA CCT GAG ATC TAC GTC CCT GAA CAA  
 G I P F E D S T P V F T P E I Y V P E Q

1450 1460 1470 1480 1490 1500  
 GAC ACT TTC TAC AAG CAG AAC CCC AAC TCC ATT GTT CGC GCC TAC CAT AGC ATT TCC CTT  
 D T F Y K Q N P N S I V R A Y H S I S L

1510 1520 1530 1540 1550 1560  
 TTG TTA CCT GAT GGC AGG GTA TTT AAC GGT GGT GGT GGT CTT TGT GGC GAT TGT ACC ACG  
 L L P D G R V F N G G G G L C G D C T T

1570 1580 1590 1600 1610 1620  
 AAT CAT TTC GAC GCG CAA ATC TTT ACG CCA AAC TAT CTT TAC AAT AGC AAC GGC AAT CTC  
 N H F D A Q I F T P N Y L Y N S N G N L

1630 1640 1650 1660 1670 1680  
 GCG ACA CGT CCC AAG ATT ACC AGA ACC TCA ACA CAG AGC GTC AAG GTC GGT GGC AGA ATT  
 A T R P K I T R T S T Q S V K V G G R I

1690 1700 1710 1720 1730 1740  
 ACA ATC TCG ACG GAT TCT TCG ATT AGC AAG GCG TCG TTG ATT CGC TAT GGT ACA GCG ACA  
 T I S T D S S I S K A S L I R Y G T A T

1750 1760 1770 1780 1790 1800  
 CAC ACG GTT AAT ACT GAC CAG CGC CGC ATT CCC CTG ACT CTG ACA AAC AAT GGA GGA AAT  
 H T V N T D Q R R I P L T L T N N G G N



FIG. 28A

Date : 2000.04.11  
 Mutant ID : 4.F12  
 Mutation : N413D(A1237G), S550(T1650A), V494A(T1481C), S610(T1830A)  
 Sequence Size : 1917

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      10      20      30      40      50      60
GCC TCA GCA CCT ATC GGA AGC GCC ATT TCT CGC AAC AAC TGG GCC GTC ACT TGC GAC AGT
A  S  A  P  I  G  S  A  I  S  R  N  N  W  A  V  T  C  D  S

      70      80      90      100      110      120
GCA CAG TCG GGA AAT GAA TGC AAC AAG GCC ATT GAT GGC AAC AAG GAT ACC TTT TGG CAC
A  Q  S  G  N  E  C  N  K  A  I  D  G  N  K  D  T  F  W  H

      130      140      150      160      170      180
ACA TTC TAT GGC GCC AAC GGG GAT CCA AAG CCC CCT CAC ACA TAC ACG ATT GAC ATG AAG
T  F  Y  G  A  N  G  D  P  K  P  P  H  T  Y  T  I  D  M  K

      190      200      210      220      230      240
ACA ACT CAG AAC GTC AAC GGC TTG TCT ATG CTG CCT CGA CAG GAT GGT AAC CAA AAC GGC
T  T  Q  N  V  N  G  L  S  M  L  P  R  Q  D  G  N  Q  N  G

      250      260      270      280      290      300
TGG ATC GGT CGC CAT GAG GTT TAT CTA AGC TCA GAT GGC ACA AAC TGG GGC AGC CCT GTT
W  I  G  R  H  E  V  Y  L  S  S  D  G  T  N  W  G  S  P  V

      310      320      330      340      350      360
GCG TCA GGT AGT TGG TTC GCC GAC TCT ACT ACA AAA TAC TCC AAC TTT GAA ACT CGC CCT
A  S  G  S  W  F  A  D  S  T  T  K  Y  S  N  F  E  T  R  P

      370      380      390      400      410      420
GCT CGC TAT GTT CGT CTT GTC GCT ATC ACT GAA GCG AAT GGC CAG CCT TGG ACT AGC ATT
A  R  Y  V  R  L  V  A  I  T  E  A  N  G  Q  P  W  T  S  I

      430      440      450      460      470      480
GCA GAG ATC AAC GTC TTC CAA GCT AGT TCT TAC ACA GCC CCC CAG CCT GGT CTT GGA CGC
A  E  I  N  V  F  Q  A  S  S  Y  T  A  P  Q  P  G  L  G  R

      490      500      510      520      530      540
TGG GGT CCG ACT ATT GAC TTA CCG ATT GTT CCT GCG GCT GCA GCA ATT GAA CCG ACA TCG
W  G  P  T  I  D  L  P  I  V  P  A  A  A  A  I  E  P  T  S

      550      560      570      580      590      600
GGA CGA GTC CTT ATG TGG TCT TCA TAT CGC AAT GAT GCA TTT GGA GGA TCC CCT GGT GGT
G  R  V  L  M  W  S  S  Y  R  N  D  A  F  G  G  S  P  G  G

      610      620      630      640      650      660
ATC ACT TTG ACG TCT TCC TGG GAT CCA TCC ACT GGT ATT GTT TCC GAC CGC ACT GTG ACA
I  T  L  T  S  S  W  D  P  S  T  G  I  V  S  D  R  T  V  T

      670      680      690      700      710      720
GTC ACC AAG CAT GAT ATG TTC TGC CCT GGT ATC TCC ATG GAT GGT AAC GGT CAG ATC GTA
V  T  K  H  D  M  F  C  P  G  I  S  M  D  G  N  G  Q  I  V

      730      740      750      760      770      780
GTC ACA GGT GGC AAC GAT GCC AAG AAG ACC AGT TTG TAT GAT TCA TCT AGC GAT AGC TGG
V  T  G  G  N  D  A  K  K  T  S  L  Y  D  S  S  S  D  S  W

      790      800      810      820      830      840
ATC CCG GGA CCT GAC ATG CAA GTG GCT CGT GGG TAT CAG TCA TCA GCT ACC ATG TCA GAC
I  P  G  P  D  M  Q  V  A  R  G  Y  Q  S  S  A  T  M  S  D
  
```

FIG. 28B

850 860 870 880 890 900  
 GGT CGT GTT TTT ACC ATT GGA GGC TCC TGG AGC GGT GGC GTA TTT GAG AAG AAT GGC GAA  
 G R V F T I G G S W S G G V F E K N G E

910 920 930 940 950 960  
 GTC TAT AGC CCA TCT TCA AAG ACA TGG ACG TCC CTA CCC AAT GCC AAG GTC AAC CCA ATG  
 V Y S P S S K T W T S L P N A K V N P M

970 980 990 1000 1010 1020  
 TTG ACG GCT GAC AAG CAA GGA TTG TAC CGT TCA GAC AAC CAC GCG TGG CTC TTT GGA TGG  
 L T A D K Q G L Y R S D N H A W L F G W

1030 1040 1050 1060 1070 1080  
 AAG AAG GGT TCG GTG TTC CAA GCG GGA CCT AGC ACA GCC ATG AAC TGG TAC TAT ACC AGT  
 K K G S V F Q A G P S T A M N W Y Y T S

1090 1100 1110 1120 1130 1140  
 GGA AGT GGT GAT GTG AAG TCA GCC GGA AAA CGC CAG TCT AAC CGT GGT GTA GCC CCT GAT  
 G S G D V K S A G K R Q S N R G V A P D

1150 1160 1170 1180 1190 1200  
 GCC ATG TGC GGA AAC GCT GTC ATG TAC GAC GCC GTT AAA GGA AAG ATC CTG ACC TTT GGC  
 A M C G N A V M Y D A V K G K I L T F G

1210 1220 1230 1240 1250 1260  
 GGC TCC CCA GAT TAT CAA GAC TCT GAC GCC ACA ACC GAC GCC CAC ATC ATC ACC CTC GGT  
 G S P D Y Q D S D A T T D A H I I T L G

1270 1280 1290 1300 1310 1320  
 GAA CCC GGA ACA TCT CCC AAC ACT GTC TTT GCT AGC AAT GGG TTG TAC TTT GCC CGA ACG  
 E P G T S P N T V F A S N G L Y F A R T

1330 1340 1350 1360 1370 1380  
 TTT CAC ACC TCT GTT GTT CTT CCA GAC GGA AGC ACG TTT ATT ACA GGA GGC CAA CGA CGT  
 F H T S V V L P D G S T F I T G G Q R R

1390 1400 1410 1420 1430 1440  
 GGA ATT CCG TTC GAG GAT TCA ACC CCG GTA TTT ACA CCT GAG ATC TAC GTC CCT GAA CAA  
 G I P F E D S T P V F T P E I Y V P E Q

1450 1460 1470 1480 1490 1500  
 GAC ACT TTC TAC AAG CAG AAC CCC AAC TCC ATT GTT CGC GCC TAC CAT AGC ATT TCC CTT  
 D T F Y K Q N P N S I V R A Y H S I S L

1510 1520 1530 1540 1550 1560  
 TTG TTA CCT GAT GGC AGG GTA TTT AAC GGT GGT GGT GGT CTT TGT GGC GAT TGT ACC ACG  
 L L P D G R V F N G G G G L C G D C T T

1570 1580 1590 1600 1610 1620  
 AAT CAT TTC GAC GCG CAA ATC TTT ACG CCA AAC TAT CTT TAC AAT AGC AAC GGC AAT CTC  
 N H F D A Q I F T P N Y L Y N S N G N L

1630 1640 1650 1660 1670 1680  
 GCG ACA CGT CCC AAG ATT ACC AGA ACC TCA ACA CAG AGC GTC AAG GTC GGT GGC AGA ATT  
 A T R P K I T R T S T Q S V K V G G R I

1690 1700 1710 1720 1730 1740  
 ACA ATC TCG ACG GAT TCT TCG ATT AGC AAG GCG TCG TTG ATT CGC TAT GGT ACA GCG ACA  
 T I S T D S S I S K A S L I R Y G T A T

1750 1760 1770 1780 1790 1800  
 CAC ACG GTT AAT ACT GAC CAG CGC CGC ATT CCC CTG ACT CTG ACA AAC AAT GGA GGA AAT  
 H T V N T D Q R R I P L T L T N N G G N



	1810		1820		1830		1840		1850		1860								
AGC	TAT	TCT	TTC	CAA	GTT	CCT	AGC	GAC	TCA	GGT	GTT	GCT	TTG	CCT	GGC	TAC	TGG	ATG	TTG
S	Y	S	F	Q	V	P	S	D	S	G	V	A	L	P	G	Y	W	M	L
	1870		1880		1890		1900		1910		1920								
TTC	GTG	ATG	AAC	TCG	GCC	GGT	GTT	CCT	AGT	GTG	GCT	TCG	ACG	ATT	CGC	GTT	ACT	CAG	
F	V	M	N	S	A	G	V	P	S	V	A	S	T	I	R	V	T	Q	

FIG. 28C

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